NEWSLETTER
April 2011
Issue 7

DITANET

Special Interest Articles:

- **DITANET Conference in Seville – Nov 9.-11. 2011**
- Position vacancies at partner institutes

Individual Highlights:

Complementary Skills Training to Support Future Researcher Careers

DITANET provides its trainees a very broad and interdisciplinary training as part of their research within the network.

Whilst this training is primarily through research, the network also organizes a number of topical workshops and training schools, such as an international 5-day complementary skills school last year.

This school equipped all trainees with skills that will be very relevant also for their future careers in both the academic and industry sectors, such as for example project and time management, scientific writing and presentation techniques.

Amongst others, the participants learned how to efficiently present their research results through talks or presentations.

The recent postgraduate poster day at the University of Liverpool gave DITANET trainees Massimiliano Putignano and Janusz Harasimowicz an opportunity to apply these skills and present their work to a very broad and mixed audience. Both did extremely well: Janusz' poster was one of only a few "highly recommended" posters out of almost 300 contributions and Massimiliano was even awarded the 2nd prize in the Faculty of Science and Engineering !

The structure of the DITANET School has now been adapted as standard for complementary skills training in the School of Physical Sciences at Liverpool University.

When the next school is organized this May, it will not "only" include several DITANET trainees, but also local Liverpool postgraduate students, as well as trainees from the ITN SOPRANO.

This is a good indication that the DITANET training ideas have started to reach well beyond the limits of the network.

Carsten P. Welsch, Coordinator

Diagnostics Conference, Seville/Spain – Nov 9.-11.

The DITANET consortium will organize an international conference on beam diagnostics in Seville/Spain.

It will bring the wider beam diagnostics community together to critically discuss the present state-of-the-art in our field, give all DITANET trainees the opportunity to present their research outcomes and serve as an ideal opportunity to discuss potential future collaboration and research challenges.

Keynote speakers from leading accelerator laboratories, universities and the industry sector will be invited to present a comprehensive overview of our field and hopefully trigger many interesting discussions.

Details can be found at:

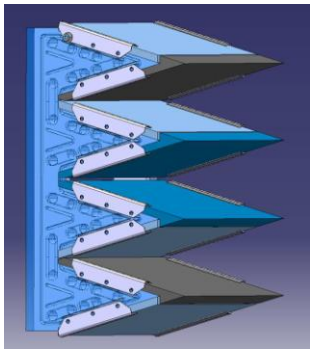
www.liv.ac.uk/ditanet

News from DITANET Partners

CERN, Switzerland *(B. Cheymol)*

Beam profile and emittance measurements for LINAC4

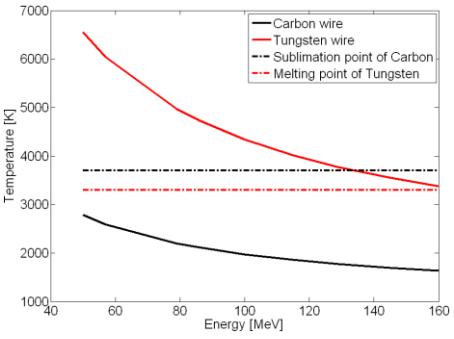
As a part of the upgrade of the LHC injector chain, the LINAC4 will replace the LINAC2 in the next few years.
This linear accelerator will accelerate H^- from 45 KeV to 160 MeV. A number of wire grids and wire scanners will be used to characterize the beam transverse profiles. In addition a slit and grid system has been developed for measuring the transverse emittance during the commissioning of the low energy part (up to 12 MeV).



Final slit design

Emittance measurements for the commissioning phase

A movable diagnostics bench will be equipped with the necessary sensors capable of characterizing the H- beam in different stages, from 3 MeV to the first DTL tank at 12 MeV. As a part of this diagnostic bench, a slit and grid system will perform the emittance measurement.
The slit design aimed at reducing the different effects that can perturb the measurement and avoiding slit damages due to energy deposition..
The slit can be considered as a beam dump, most of the beam is stopped inside it. Considering the nominal beam parameters for the commissioning phase (100 µs pulse length and an intensity of 65 mA), the thermal load would damage on the slit.



Temperature evolution for 100 µm diameter Carbon and Tungsten wire as function of beam energy, for a LINAC4 40 mA, 400 µs pulse and typical beam sizes at the monitors locations.

Analytical calculations and numerical simulations performed in collaboration with the EN/MNE group at CERN using the Monte Carlo Code FLUKA and the Thermo mechanical simulation ANSYS have shown that the best material for the slit is graphite. The slit geometry has been chosen to dilute the energy deposition over the maximum available graphite volume (given the integration constraints).
The final design of the slit consists in several graphite blades positioned at an angle of 15° with respect to the beam axis. A 3D drawing of one of the slit blades is shown to the left.
The scattering effect on the slit edges and the space charge effect have been also simulated using FLUKA and PATH to find the best slit aperture and thickness.

Wire beam scanners and SEM grids for LINAC4

In order to measure beam profiles along the linac, several SEM grid and wire beam scanner (WS) monitors will be installed between the RF cavities from 50 MeV to 160 MeV. Two wire scanners will also be installed at the chopper located in the 3 MeV MEBT line. The SEM grids are retractable devices that will be inserted into the beam in a single step, while WS are driven by stepping motors that will allow slow scans of the particle distribution over multiple beam pulses.

Signal generation

For H^- beams, the signal on the wire is generated by Secondary Emission (SE) induced by the particles entering or exiting the wire and the charge deposition of proton or stripped electrons. For the LINAC4 SEM grid and WS monitors, two types of wire are presently considered: 40 µm diameter Tungsten wires and 33 µm diameter Carbon wires. Between 50 and 160 MeV, the electron range is below the wire diameter for Tungsten, while it becomes of the order of the wire diameter for Carbon for ion energies of about 100 MeV. For both Carbon and Tungsten the proton range is well above the wire diameter and all protons will escape generating SE. Above 110 MeV the Carbon wire signal changes polarity and is reduced by at least a factor 50. For Tungsten, the signal polarity is always negative and the net charge almost constant with energy. A positive bias voltage could be applied on the wire in order to avoid SE. In this case a Tungsten wire provides a constant signal at all energies.

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News from DITANET Partners

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Considering nominal beam sizes, the central wire will give a signal of few mA.

Thermal load

The thermal load induced on the wires by the beam can produce thermo-ionic emission of electrons that would perturb the measurement. If the wire temperature increases further, the wires can break due to melting or sublimation. The thermal load induced by nominal LINAC4 beam (I=40mA, 400 µs pulse length) is too high for Tungsten wires. The increase in temperature is lower with Carbon wires, but the signal is also lower. In order to keep the signal at a sufficient level for good profile measurements, the final design of the Wire Beam Scanner and SEM grid will use Tungsten wires. Nevertheless, the pulse length has to be reduced to 100 µs, to prevent any damage on the wire.

Fermilab, USA *(G. Tassotto)*

Monitor for High Intensity Beams Using 33 μm Carbon Monofilament

A prototype profile monitor using carbon monofilaments was built for the purpose of reducing the beam losses in the high intensity beamlines.

The NuMI beamline delivers a high intensity proton beam of 3.5 E13 protons per pulse (ppp) in 8.6 μsec with a cycle time of 1.8 seconds on a target. At the location of the detector the beam has a σ_H = 1.08 mm and a σ_V = 1.18 mm. Since the detector was installed it has received a total integrated intensity of over 10^{20} protons.

The detector, PM118, is made by first winding a 33 μm diameter carbon monofilament (wire) made by Specialty Materials Inc. The wire has a density of 1.8 g/cc. It is wound at a pitch of 1 mm and at 12 g of tension on an aluminium transfer frame. The transfer frame is then positioned over a ceramic board where the monofilaments are epoxied to the pads using silver based conductive epoxy H20E made by Epoxy Technology, Inc.
The figure to the right shows the wire plane assembly, the kapton tape that takes the 48 active signals per plane to the feedthoughs, and a kapton coated wire used to verify that all the wires are properly connected. The vacuum can is positioned at 45 degrees to allow motion of the ceramic board without interfering with the beam during IN/OUT motion of the detector thereby preventing the beam from hitting the ceramic substrate.
Profiles have already been measured with the PM118 detector and were compared with other measurements: PM101 which has 25 μm diameter Ti wires at a pitch of 1 mm and PMTGT which is the target foil SEM, built by University of Texas at Austin, which has a thickness of 5 μm and a width of 125 μm Ti at a pitch of 0.5 mm. Tests are presently conducted to determine the relative beam losses.

The beam motion of a fraction of a wire space (fraction of a mm) is not surprising. The beam position drifts slowly and is then returned to nominal There is a small continuous decrease of the gain of PM118 during this sample. Because of this regular movement of the beam, there is a constant perturbation of the gain. Even after a long time, a large (compared to the regularly small shifts) beam position change will result in a gain change.
The change in gain with accumulated intensity has been simulated recently.

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Image of the profile monitor

News from DITANET Partners

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The position resolution of the detector compared to the BPM (weighted sum of the positions from the 5 batches) was checked using a special sample that included a beam shift. Data with a beam shift makes it possible to check the BPM position calibration relative to the PM118 position measurement. The position resolution was found to be 22 μm.
Tests are continuing, final results will be published at a later date.

Recent Events

3rd DITANET School on Beam Diagnostics

Stockholm, Sweden
7th-11th March 2011

From March, 7th – 11th 2011 an advanced DITANET School on Beam Diagnostics took place in Stockholm, Sweden. The event was hosted by Manne Siegbahn Laboratory with Anders Källberg as local organizer.

The School was combined with the network's annual meeting and brought together around 100 researchers from major research centres, universities and private industry from all over the world. It started with a recap of some of the key concepts introduced during the first school back in 2009. Helmut Wiedemann, Professor emeritus from Stanford University, started with an introduction to accelerator physics, before beam profile and beam position measurements were covered in one hour lectures by leading experts in the respective field.
During the week, beam instrumentation for specific applications, such as low energy accelerators, light sources, colliders or high intensity accelerators were presented in detail.
The intense lecture program was complemented by dedicated Question & Answer sessions, as well as focused tutorials.

In addition, participants were given the opportunity to present their own work in this interdisciplinary field in a poster session that triggered many interesting discussions.

An excursion to the island of Utö, a one hour boat ride through ice-covered waters from Stockholm, on Wednesday and a dedicated industry session on Friday rounded up a week that was found extremely enriching by all participants.

Full details:

CERN Indico,
confId = 112220

Recent Events

Meeting of the DITANET Steering Committee

Stockholm, Sweden
10th March 2011

The 6th meeting of the DITANET Steering Committee took place on Thursday 10th March as part of the week-long DITANET School on Beam Diagnostics held in Stockholm.
Two new members of the Committee have recently been elected following the stand down of Peter Forck (GSI) and Andreas Peters (HIT).
Paolo Finocchiaro representing the research centre INFN-LNS, Italy and Kevin Oliver representing industry from Diamond Detectors, UK have now taken their places on the Committee.
In addition, the annually elected trainee representative to the Committee, Marion Ripert (HIT), stood down and was replaced by Nirav Joshi (Royal Holloway University of London).
Planning for the forthcoming Topical Workshop on Detectors (7th and 8th November 2011) and the DITANET international conference (9th to 11th November 2011), both hosted by the University of Seville/CNA was finalised and further details will be issued shortly.
Additional workshops were approved, including one on beam position monitors at CERN and on diagnostics for high intensity accelerators at CEA.
Topical Workshops on beam loss measurements and technology transfer are in the planning stages.
Information about all future events will be made available via the network's web page.

The Steering Committee consists of elected senior scientists and is responsible for the implementation of the overall network strategy, it also oversees all research projects and activities.

Meeting of the DITANET Supervisory Board

Stockholm, Sweden
11th March 2011

The annual meeting of the DITANET Supervisory Board took place on Friday 11th March at the end of the DITANET School on Beam Diagnostics
The meeting brought together representatives of all DITANET partners and the network's trainees.
During the meeting, the new Adjunct Partners, University of Dundee, University of Uppsala, Fermilab and Diamond Detectors were welcomed and presented the group an overview of their reseach activities in beam diagnostics.
In addition, the network sought feedback from the trainees themselves on their overall research progress. The meeting also provided them a platform to raise questions with regard to their training within the network.

Each DITANET partner has one representative in the Supervisory Board. Its role is to oversee the overall training strategy. In particular to ensure that all trainees are provided with a skills set that gives them excellent base for their future careers and that all projects include industry-relevant training aspects.

New to the Network

Leonid Sukhikh

Leonid Sukhikh joined the *Maschine, Diagnose und Instrumentierung* (MDI) group at DESY (Hamburg, Germany) in January 2011 as a DITANET Experienced Researcher to work on a project of short (300 fs) bunch length diagnostics, based on coherent Smith-Purcell radiation from a tilted target.
On February 22, 2007 Leonid has finished his graduate education at Tomsk Polytechnic University (Russia) as engineer-physicist with specialization in "Physics of atomic nuclear and elementary particles". His diploma thesis "Focusing of diffraction radiation generated by a parabolic target" was based on the results of a joint experiment at KEK-ATF (Tsukuba, Japan) devoted to the investigation of optical transition and diffraction radiation from a concave target.
On December 2, 2009, Leonid has defended his PhD thesis "Focusing of transition and diffraction radiation by concave targets" under the direction of Prof. Alexander Potylitsyn at the Nuclear Physics Institute of Tomsk Polytechnic University.
His thesis not only included incoherent radiation focusing but also the focusing of coherent radiation.
After his thesis, Leonid worked at Tomsk Polytechnic University as an assistant.

His scientific work within DITANET is devoted to the investigation of different kinds of radiation and the exploitation of the radiation characteristics for diagnostics purposes.

Welcome !

Position Vacancies

University of Liverpool / Cockcroft Institute, UK

The QUASAR Group at the Cockcroft Institute is specialized in the development of beam diagnostics methods for low and high energy accelerators, as well as for light sources.

There are presently PhD project opportunities within the group in the fields of beam instrumentation for medical accelerators, diagnostics of ultra-cold electron beams or beam loss monitoring and machine protection for future colliders.

Interested candidates should contact carsten.welsch@quasar-group.org for further information. They will be expected to work within an international group, should have good background in electromagnetism, accelerator R&D, atomic and/or particle physics and would normally have completed their first degrees with excellent results.

Fermi National Accelerator Laboratory (Fermilab), USA

DITANET Adjunct Partner Fermilab is advertising vacancies for Fellowships.

Based in Batavia, Illinois Fermilab operates a large proton accelerator complex for high energy physics experiments. The laboratory employs a beam instrumentation team of some 30 technicians, engineers and physicists who support a very large variety of beam diagnostics systems. Most key technologies are developed in-house, such as for example digital signal processing techniques, EM modelling and optimisation of beam pickups, etc. Full details of these posts can be found at:

www.fnal.gov/pub/forphysicists/fellowships/index.html

DITANET

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Examples of Recent Publications/Presentations:

Publications:

Cosentino, L., Finocchiaro, P., Pappalardo, A. "A beam diagnostic multisensor for low energy radioactive beams", Nucl. Instr. Meth. A 622 (2010) 512-517

Miguel A. Cortés-Giraldo et al, "Geant4 Simulation to Study the Sensitivity of a MICRON Silicon Strip Detector Irradiated by a SIEMENS PRIMUS Linac", Prog. Nucl. Sci. Tech., *accepted* (2011)

C.P. Welsch, "Longitudinal Beam Profile Measurements within DITANET", Proc. Part. Acc. Conf., New York City, USA (2011)

C.P. Welsch, "Low Energy, Low Intensity Beam Diagnostics within DITANET", Proc. Part. Acc. Conf., New York City, USA (2011)

DITANET Events 2011	
October 31st	Deadline for applications for annual DITANET Prize
November 7th – 8th	Topical Workshop on Detector Technologies Seville, Spain
November 9th – 11th	DITANET Conference on Beam Diagnostics Seville, Spain
Other Interesting Events	
May 16th - 18th	DIPAC Workshop, Hamburg, Germany
June 9th- 14th	TIPP 2011, Chicago,USA
September 4th - 9th	IPAC Conference, San Sebastian, Spain
April 15th – 19th 2012	Beam Instrumentation Workshop, Newport News

NOTICE BOARD

DEADLINE FOR THE NEXT NEWSLETTER
17th June 2011

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.

PEOPLE

UNIVERSITY OF LIVERPOOL

MARIE CURIE ACTIONS