Newsletter
June 2013
Issue 5

'LA³NET – An excellent ITN'

Special Interest Articles

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Individual Highlights

- Mid-Term Review Meeting
- LA³NET at IPAC13

This was only one out of many very positive and encouraging comments the EU reviewers made about the LA³NET project. After 21 months it was time this month to meet for the project's **mid-term review meeting**. This is a very important meeting when EU representatives and an external reviewer have a critical look at the project progress and the R&D work of our fellows. It brought all our trainees and their supervisors to Copenhagen, Denmark and was kindly hosted by our partner Danfysik.

You will find a more detailed summary in this newsletter edition, but what I should already mention here briefly is that the outcome was overwhelmingly positive. This is a fantastic result for the project and a good recognition of the hard work everybody put in since we started in 2011. I cannot thank all partners enough for their contributions ! We will certainly use this positive feedback as additional motiviation to maintain the network's current momentum.

Following the project's initial plan closely, a week-long **complementary skills school** was held for all LA³NET fellows this spring in Liverpool, UK. The concept for this school was initially developed for the DITANET fellows and has since been adapted as a standard training course for post-graduate research (PGR) students in Liverpool's school of physical sciences. The school combines both areas that are of particular relevance for the current research projects of our fellows, such as scientific writing, presentation skills or project management, as well as more generic skills which shall support them during their careers, e.g. scientific outreach, networking, careers in industry and academia. Our fellows worked very hard and closely together during this intense training week which also helped them understand their individual research projects and challenges better. More details can be found from page 10 onwards.

More events are already in the planning: **Topical Workshops** on *Optics Design* (ILT, Germany) and *Novel Acceleration Schemes* (HZDR, Germany) shall be organized between 4th-6th November 2013 and 28th-30th April 2014, respectively. In addition, an **International School** on *Advanced Laser Applications at Accelerators* shall be held at CLPU in Salamanca, Spain in autumn 2014. As usual, all events will be open for participants from inside and outside the LA³NET consortium. Places will be strictly limited, so make sure you register for our *newsletter* or follow us on *Facebook* to get information first hand.

Finally, I would like to mention that the deadline for the annual **LA³NET prize** is approaching quickly and all applications should reach us by the end of this month. Full details can be found as usual on our web page.

Enjoy this newsletter

Prof. Carsten P. Welsch, Coordinator

Mid-Term Review Meeting

LA³NET – 'A project to be proud of'

These were the words of the Project Officer from the European Commission (EC) in the summing up of what was also described as an excellent project by the external reviewer.

The LA³NET Mid-Term Review took place on Monday 17th June 2013 and was hosted by Danfysik in Copenhagen. The meeting kicked-off with a welcome from our hosts Dr. Søren Stjernqvist, President of Danish Technological Institute and Dr. Bjarne Roger Nielsen, CEO of Danfysik A/S followed by an introduction by the EC representatives from the Research Executive Agency (REA), the Coordinator and the Scientists-in-charge. Prof. Carsten P. Welsch then presented an overview of progress made in research, training and networking, as well as aspects of the management of the contract.

Dr. Rob Ashworth, LA³NET Project Manager, then spoke about the events delivered so far, plans for the remainder of the contract and dissemination before the elected fellow spokesperson Andrii Borysenko delivered a most positive and convincing account of the fellows' perspective.

Finally, the fellows presented in turn about themselves, their projects and experiences of the network. All fellows then met with the EC representatives to discuss their experiences and views on the project in more detail. Meanwhile the consortium representatives gathered for a Supervisory Board meeting to discuss and plan future events.

The meeting reconvened after coffee for the two EC representatives to report on their impression of the network and make suggestions for the remaining period. The project officer summed up saying that it was an excellent Initial Training Network (ITN) with many particularly good aspects. They could see that all of the fellows were happy as shown by the anonymous questionnaires completed beforehand and discussion on the day. They also highlighted the real industry involvement and growing number of adjunct partners, as well as efforts and achievements in communication, coordination and dissemination by the EU T.E.A.M. as exceptionally successful areas.

'This is an excellent ITN project.'

They were also impressed with the researcher prize which was novel to them and the cohort of ESRs which was remarkable. The fellows themselves were dynamic and it was the first time that the tables had been turned on them during the ESR discussions and they had been given recommendations to take back to Brussels.
The project officer also had recommendations for maintaining project momentum stating that partner organisations should start thinking now about how the fellows may be supported to complete their PhDs after the project has ended. The full power of the network should be used to continue with the programme of secondments.

'We were impressed by the quality of the consortium, the events and the work of the ESRs.'

The external reviewer added how impressed they were with the quality of the consortium, training, events, and the research work of the ESRs.

A tour of the Danfysik facilities on Tuesday morning followed by an excursion to the Carlsberg brewery for discussions in a more relaxed environment completed this important event.

Well done to all who contributed to a highly successful three days in Copenhagen !!

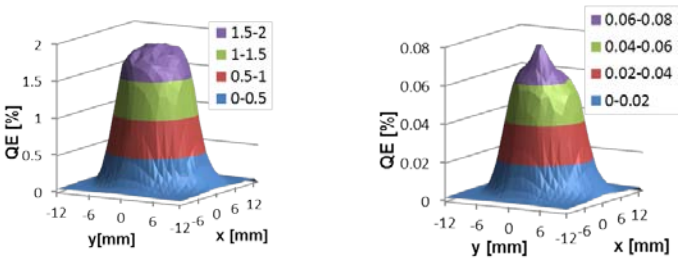
Also, not least, a special thank you to Danfysik for hosting the event, in particular Dr. Arnd Baurichter, Jakob Krämer and Dr. Michael Budde for sorting out all the local arrangements and ensuring that it all ran so smoothly.

LA³NET Impact at IPAC

A variety of LA³NET partner organizations were represented at IPAC 13 in Shanghai in May with industry booths and scientific contributions. Prof. Carsten Welsch presented a generic LA³NET poster acting as a hub to direct relevant traffic to other project presentations. The following contributions of research results from LA³NET fellows show examples of the work being carried out in three of the main work packages: laser-based particle sources, lasers for beam instrumentation and laser-driven particle beam acceleration.

Investigations into Cs_3Sb cathodes for the CLIC drive beam photo injector

Within the Compact Linear Collider project, a photo injector is an interesting alternative for the drive beam to the baseline design thermionic electron gun. Investigations are currently carried out into both the laser and photocathode. Whilst the available laser pulse energy in the ultra-violet is currently limited by optical defects in the 4th harmonics frequency conversion crystal induced by the 0.14 ms long pulse trains, recent measurements of Cs_3Sb photo cathodes sensitive to green light showed their potential to overcome this limitation. Moreover, using visible laser beams leads to better stability of the generated electron bunches, opening up opportunities for using higher quality optics. LA³NET fellow Irene Martini has started investigations into Cs_3Sb photo cathodes.



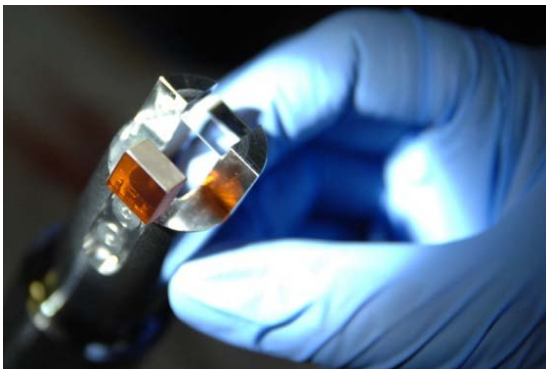
QE map of Cathode #192 before (left) and after (right) measurement at 120 µA.

These cathodes have been produced and characterized at the CERN photoemission laboratory, where a dedicated preparation setup and a 70 keV DC electron gun including a diagnostic beam line are available [1]. For measuring the electron beam current a Wall Current Monitor (WCM), a Fast Current Transformer (FCT) and a Faraday Cup (FC) are installed. The figure above shows Quantum Efficiency (QE) maps where scans of the cathode surface with a pencil laser beam have been performed, immediately after cathode production (left) and following high average current measurement (right). It can be seen that the initial flat top distribution experienced an overall QE reduction, which can be attributed to pollution of the cathode due to the beam induced high vacuum level. In addition a peak with QE=0.8% can be observed in the centre of the cathode, where the laser beam hits the cathode. The transversal dimensions of this peak are comparable to the estimated laser beam spot size. Although detailed investigations are on-going a possible explanation of this peak might be the laser cleaning process, which is in competition with QE degradation. Similar observations were made previously during high current electron beam production with Cs_2Te and UV laser beams in the same setup [2]. Further details about recent measurements can be found elsewhere in these proceedings [3].

[1] E. Chevallay, CTF3 Note 104, CERN (2012).
[2] E. Chevallay et al., CTF3 Note 020, CERN (2001).
[3] I. Martini, et al., "Studies of Cs_3Sb cathodes for the CLIC drive beam photo injector option", Proc. IPAC, Shanghai, China (2013), 413-415. MOPFI058 .

Electron Bunch Shape Detection

Typically, synchrotron light sources use incoherent light in their experiments. Coherent synchrotron radiation arises when the longitudinal electron bunch length is smaller than the wavelength, which can normally only be achieved for relatively long wavelengths in the (sub-) THz regime. Substructures on the electron bunches (micro-bunching) can then lead to strong «bursting» in the emission of coherent radiation. The physics behind these effects is still poorly understood, mainly because it is rather difficult to measure the bunch profile with sufficient temporal resolution.



Photograph of an electro-optic GaP crystal, mounted on its support (image courtesy of Nicole Hiller, KIT)

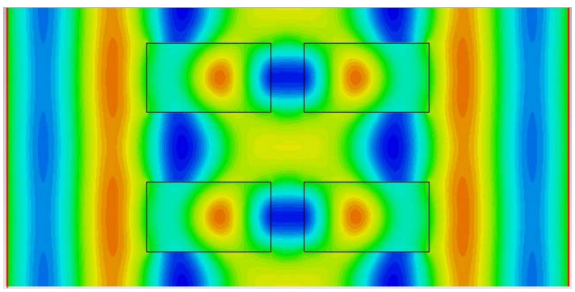
Electro-optic measurement uses the linear electro-optic or so called «Pockels» effect. This effect – usually a change in polarization, which is turned into a change in optical power at a polarizer – can then be measured with a photo detector yielding the bunch signal. Andrii Borysenko is carrying out a project aiming at the realization and use of a high resolution electron bunch shape detection system at the new linear accelerator FLUTE, currently being designed at KIT, Germany [4]. Within his project he is designing and building up an electro-optic system for FLUTE. For this purpose, a system currently being developed for the ANKA ring shall be adapted. In addition, studies into performance limitations with regard to temporal resolution shall be carried out.

Andrii has also been involved in associated wakefield simulation work [5].

[4] N. Hiller, A. Borysenko, et al., „Electro-optical Bunch Length Measurements at the ANKA Storage Ring“, Proc. IPAC, Shanghai, China (2013), 500-502. MOPME014.
[5] B. Kehrer, A. Borysenko, et al., „Numerical wakefield calculations for electro-optical measurements “, Proc. IPAC, Shanghai, China (2013), 503-505. MOPME015.

Fibre optics electron accelerator

Photonic crystals are a promising way to realize an on-chip electron beam source for fundamental radiation biology. They provide a unique combination of nanometre beam size and attosecond-short pulses which would be beneficial for use in microscopic and ultra-fast analyses of damage and repair of radiation-irradiated DNA and chromosomes. Currently, there are three different candidates for photonic crystal accelerator structures: the dual-grating structure, photonic crystal fibres and the woodpile structure. Aimierding Aimidula, a fellow in the QUASAR Group at the Cockcroft Institute/University of Liverpool, UK has started simulation work on a new dual-grating structure, based on work from Plettner [6]. By carefully adjusting the position of the pillars, it can be used to efficiently modify the laser field. The operating principle of this structure is based on a decrease of the phase velocity of the electric field and its synchronization with non-relativistic and relativistic electrons. Different structure geometries have been studied with regard to maximum achievable field gradients and field distribution along the structure.



Field distribution as calculated with CST Microwave Studio in dual-grating structure.

With λ being the wavelength of the operating laser, the structure features a lattice length of λ, as well as pillar and vacuum lengths of λ/2. The driving laser light is fed from the two outer surfaces, perpendicular to the direction of motion of the electrons. The laser light then traverses through both vacuum and the grating pillar, leading to different velocities. Thereby the necessary phase delay of π and hence a periodic electric field distribution inside the vacuum channel along the longitudinal beam axis can be generated. The above figure shows the z-component of the electric field distribution with z being the direction of motion of the electron beam. Along the vacuum channel, regions of opposite field strength are separated by λ/2 which will allow relativistic electrons to catch up with oscillating electric field and be accelerated.

Optimum pillar height and vacuum channel gap are determined in simulation runs. For electric field calculation CST Microwave Studio was used. It can be seen from the CST figure above that a two side feeding mechanism efficiently decreases the transverse field, i.e. the x-component of the electric field, perpendicular to the direction of travel of the electrons, which is unusable for longitudinal acceleration. A laser wavelength of 1,550 nm was chosen for all simulations. Several dielectric materials have good transparency at this wavelength and the final material is chosen on the basis of its transparency range, the electric field damage threshold, its thermal conductivity, nonlinear optical coefficients, chemical stability and refractive index. In the first studies silicon was used, which has a refractive index of n=1.527. Detailed results can be found in [7].

[6] T. Plettner, P. P. Lu, and R. L. Byer, "Proposed few-optical cycle laser-driven particle accelerator structure", Phys. Rev. ST Accel. Beams 9, 111301 (2006).

[7] A. Aimidula, et al., "Design of a Photonic Crystal Accelerator for Basic Radiation Biology", Proc. IPAC, Shanghai, China (2013), 1283-1285. TUPEA065.

Laser based stripping system for measurement of the transverse emittance of H- beams at the CERN LINAC4

The new LINAC4 at CERN will accelerate H^- particles to 160 MeV and allow high brightness proton beam transfers to the Proton Synchrotron Booster, via a charge exchange injection scheme. Thomas Hofmann's contribution to IPAC was a paper describing the conceptual design of a laser system proposed for transverse profile and emittance measurements based on photon detachment of electrons from the H^- ions. The binding energy of the outer electron is only 0.75 eV and can easily be stripped with a laser beam. Measuring the electron signal as function of the laser position allows the transverse beam profile to be reconstructed. A downstream dipole can also be used to separate the laser neutralized H^0 atoms from the main H^- beam. By imaging these H0 atoms as a function of laser position the transverse emittance can be reconstructed in the same way as in traditional slit-and-grid systems. By properly dimensioning the laser power and spot size, this method results in negligible beam losses and is therefore non-destructive. In addition, the absence of material intercepting the H^- beam allows the measurement of a full power H^- beam. The paper focussed on the general design and integration of both the laser and H^0 detector systems.

In the context of the development of a laser based transverse emittance measurement, the parameters of the main components, the laser and the H^0 detector were studied and the choices of suitable components were narrowed. The interactions of the particles with the laser were modelled. Furthermore the background level due to residual gas stripping was calculated and first measurements in this regard were accomplished at the 3 MeV test stand.

Further details can be found here [8].

[8] T.Hofmann, et al., "Laser based stripping system for measurement of the transverse emittance of H- beams at the CERN LINAC4", Proc. IPAC, Shanghai, China (2013), 652-654. MOPME075.

Competitions

Last chance to enter the Researcher Prize 2013

The deadline for this year's Researcher Prize is 30th June 2013 with €1,000 up for grabs for the researcher judged to have made an important contribution to the field of laser application at accelerator facilities. The competition is open to all researchers in the first five years of their research careers both from within or outside of the network.

More information can be found here:
www.liv.ac.uk/la3net/la3net_prize/

Libera Challenge

Instrumentation Technologies is a Slovenian company and partner in oPAC that supply high performance instrumentation for particle accelerators. They have set the Libera Challenge to find the most original measurements made using Libera equipment as judged by a panel of Libera users. This competition is open to all with the winner to receive a prize of €700 plus fully-paid participation in the 10th Libera Workshop in 2014. For more details visit the website:

www.i-tech.si/announcements/libera-challenge_2

Vacancies in the Network

Pending favourable defence of their MSc project there is a candidate lined up to take up the LA³NET position available on the **Development of a 3D neutron detector for complex geometries** at IFIN-HH in Romania.

The post hosted by STFC in the UK remains open for applications via the LA³NET website for the project on **Ultrafast lasers for accelerator timing**. The post is based at STFC Daresbury National Laboratory and the project will be carried out in collaboration with the University of Manchester Photon Science Institute in the UK.

www.liv.ac.uk/la3net/projects/stfc/

Partner News

New Adjunct Partner LMU

The LA³NET network swells to 31 partners with new adjunct partner Ludwig Maximilian University of Munich (LMU) from Germany.

The newly established Chair of Experimental Physics - Medical Physics in the Faculty for Physics of the **Ludwig-Maximilians-Universität München (LMU)** aims to promote research and teaching in the field of medical physics, with special focus on advances in pre-clinical and clinical radiotherapy. The R&D activities include new detector developments for dosimetry and in-vivo imaging as well as analytical and stochastic (Monte Carlo) computational methods for application to a wide range of beam modalities, from established conventional sources of photons and hadrons up to laser-based systems.

Cosylab Student Exchange Programmes - R. Tavcar, F. Amand (COSYLAB)

COSYLAB
CONTROL SYSTEM LABORATORY

A New Programme

On 13 May 2013, at the 4th International Particle Accelerator Conference (IPAC13) in Shanghai, China, the SINAP-COBIK Hi-Tech Student Exchange Programme was established by Prof. Shin-Ichi Kurokawa (Vice President of Cosylab Japan) and Dr. Lixin Yin (Deputy Director of SSRF, SINAP).

This programme will enable the exchange of students between Cosylab and the Shanghai Institute of Applied Physics (SINAP) [1] for approximately 1 month between August and September. The Programme is structured in a way that the student is able to gain valuable experience working at the host institution and still have enough free time to explore the host country.

Slovenian students will work at China's flagship experimental research facility, the Shanghai Synchrotron Radiation Facility (SSRF) [2] learning first-hand about accelerator problems, seeing what goes on during an accelerator shutdown/maintenance and experiencing Chinese culture. Chinese students will spend time at Cosylab in Ljubljana, learning the ins-and-outs of instrumentation and control systems. Each student will be assigned a concrete task that provides a valuable learning experience, for example, to integrate a device into EPICS, develop hardware, software or an FPGA FW module, setup a measurement station, perform measurements, tune instruments, etc.

"This programme is one of the items realized under the Cooperation Agreement between SINAP and COBIK, signed in 2010. Starting from this programme, a strengthened and deep collaboration between SINAP and COBIK can be foreseen and this will benefit both sides in the long-term development of accelerator technology." says Dr. Lixin Yin.

Giving Back

Cosylab owes its existence to the scientific community and has fared well in the last 11 years, so now it is time to give back. The student exchange program with SINAP joins similar agreements that Cosylab has with DESY, Lund University, and the University of Ljubljana. These programmes have the advantage of strengthening the Lab-Student-Cosylab relationship. Furthermore, Cosylab has experience that it is willing to share.

Students from Institutes receive training in core technologies from the various experts at Cosylab. For Cosylab the student exchange programmes are an opportunity to foster relations with institutes by developing personal relationships that help improve communication.

Open Invitation

If you send us your best students, our experts will help them gain experience about real-world problems. Contact Rok Tavčar at rok.tavcar@cosylab.com if you are interested in setting up a Student Exchange Programme between your Institute and Cosylab.

References

[1] http://english.sinap.cas.cn/
[2] http://ssrf.sinap.ac.cn/english/

Recent LA³NET EVENTS

Innovation in Researcher Training: the Complementary Skills School, March 17th - 22nd 2013, University of Liverpool, UK

The LA³NET fellows descended on Liverpool from their host countries on Sunday 17th March taking advantage to meet up ahead of the rigorous but unknown schedule that lay before them.

Monday Day 1: The School kicked off at the University of Liverpool's Foresight Centre with a fun exercise of paired introductions. This enabled the fellows to get to know one another better through one to one interviews followed by poster preparation and presentations about each other. Already the natural talent was beginning to show with some colourful, out-of-the-ordinary posters and humorous presentations.

The remainder of the day was taken up with sessions on presentation skills and an introduction to project management delivered by Prof. Carsten P. Welsch. This included the fellows applying these principles to their own projects by carrying out stakeholder analyses and setting deliverables and milestones.

In the evening a guided tour of Liverpool was taken aboard the Duck Marine Tour. The duck is an amphibious vehicle from the 2nd World War painted yellow that traverses the city before plunging into the docks for alternative views of the Three Graces and other dockside buildings.

The cultural tour of Liverpool was taken on an amphibious craft

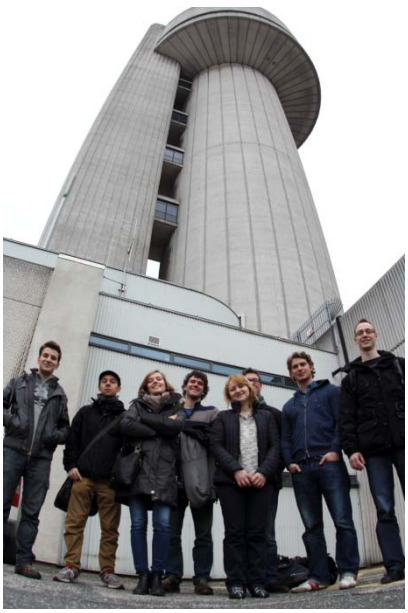
Tuesday Day 2: The day started with invited speakers from industry and academia talking about experiences in their chosen career. John Schofield from Lissajous Nucleonics Ltd talked about his adventures working in the nuclear industry. This was contrasted with the alternative pathway of academia described by Prof. Peter Butler from the University of Liverpool's Physics Department.

Next the team was split into groups of five and tasked with using the project management tools taught in the School to develop a project plan for an outreach event with a budget of £10,000 to be submitted as a proposal for review by an evaluation committee. The afternoon was taken up with an interactive session on scientific writing delivered by Matthew Chalmers who is a particle physicist and experienced editor. Here the fellows developed their approach to writing papers for targeted journals and concluded with how to present science to the general public.

Wednesday Day 3: Dr. Rosa Letiza from Lancaster University joined Prof. Carsten Welsch, as well as Helen Williams and Dr. Rob Ashworth from the EU Project T.E.A.M. to guide the three groups in optimizing presentations.

Each fellow delivered a pre-prepared presentation of their project which was videoed and played back for self-analysis and constructive critical discussion.

After lunch the fellows visited the Sci-Tech Daresbury for a presentation about the Cockcroft Institute by Prof. Swapan Chattopadhyay followed by a tour kindly provided by our ASTeC colleagues of the laboratories, the accelerator facilities and the Versatile Electron Linear Accelerator (VELA, formerly EBTF) under construction at the Daresbury site. The evening bonding event was the white knuckle LA^{3}NET Grand Prix at Speedkarting, Warrington.



LA^{3}NET fellows standing before the Daresbury tower – a former Van der Graaff type acceleratar

Thursday Day 4: The LA^{3}NET fellows applied the skills gained in the first 3 days of the School to develop a robust project plan as a bid for outreach funding. Each of the three teams prepared a 1,500 word proposal and supporting presentation by the end of the day.

This was interspersed with talks on advanced aspects of project management delivered by Fraser Robertson of Fistral Training.

At the formal evening dinner at the Alma de Cuba in Liverpool a few fellows commented that they had not sampled the delights of English cuisine all week – never mind. It was another fine English Spring day - on emerging from the restaurant we faced heavy snow and gales.

Friday Day 5: It was still snowing. First of all Dr. Dave Joss gave a presentation of the history of physics at the University of Liverpool and a guide to the peer review process. Next, the fellows faced their final challenge of the week to present their proposals for the outreach activity and to peer review each other's submissions and vote for the winning bid. It was gratifying to see that all three proposals were well constructed incorporating many of the aspects covered throughout the week and all three were well presented. The peer review was well received by each group and consensus was reached that the winning proposal was the Subway zoetrope. The School ended with a video of photographs and clips from the week before everyone dispersed into the snow one last time.

Joke Box

If it wasn't for Thomas Alva Edison, we'd all be watching TV by the light of a candle.

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LA³NET Events

November 4th-6th 2013	Laser Technology & Optics Design Topical Workshop, ILT, Germany
April 28th – 30th 2014	Topical Workshop on Novel Acceleration Schemes, HZDR, Germany
September 2014	School on Advanced Laser Applications at Accelerators, CLPU, Spain

Other Events

August 26th – 29th 2013	FEL2013, New York City, USA
Sept 2nd – 6th 2013	AOIM2013, Stellenbosch, South Africa
Sept 9th – 11th 2013	UCMMT2013, Rome, Italyl
Sept 16th – 19th 2013	IBIC, Oxford, UK
Sept 23rd – 27th 2013	SRF2013, Paris, France
Sept 23rd – 27th 2013	18th Colloque GANIL, Port-en-Bessin, France

NOTICE BOARD

Now is the time to ensure that career development plans are being implemented and that reviews are carried out to update them for the second year. Particular attention should be made to commitments to deliver outreach activities such as the production of webcasts to explain scientific ideas related to your research and visits to inspire children and students in local schools.

DEADLINE FOR THE NEXT NEWSLETTER
August 30th 2013

About LA³NET

The exploitation of Lasers for Applications at Accelerator facilities for ion beam generation, acceleration and diagnostics is the goal of this new Network within the FP7 Marie Curie Initial Training Network (ITN) scheme. In this frame, research centres, universities and industry partners from across Europe will develop beyond-state-of-the-art techniques and technologies through a joint inter-sectoral training program for early stage researchers within a unique European partnership.

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