

New research infrastructures and technologies, researcher training and upcoming events

For Europe to remain competitive in science it is of crucial importance to design, build and operate world-class research infrastructures. A low repetition rate, plasma-based Free Electron Laser (FEL) would be a fantastic addition to existing facilities. The LA³NET project hosted a meeting with core partners from the EuroNNAC consortium at the Cockcroft Institute, UK in June where the exact scope of a H2020 Design Study proposal along with several bids about emerging technologies that are expected to be critical for Europe's leading role in science and technology were discussed.

LA³NET training is a role model. Providing early career researchers with complementary skills training is considered to be of very high importance for their future careers. A new training concept was pioneered within the network and selected as 'best practice' by the Faculty of Science and Engineering at the University of Liverpool, as well as the EU as part of the project's mid-term review meeting. The Higher Education Academy has organized a one day workshop at the Cockcroft Institute so this successful concept can also be considered at other higher education institutions. This meeting led to many interesting discussions with researcher skills trainers, EU project managers and student experience administrators from across the UK. The experiences gained were further discussed at the Euro Science Open Forum (ESOF) in Copenhagen where I was invited to host several sessions on accelerating researcher training. LA³NET project manager Dr. Rob Ashworth, Fellows Jakob Krämer and Andreas Döpp, as well as

our Danfysik collaboration partners Drs. Arnd Baurichter, Michael Budde and former CEO Bjarne Roger Nielsen all contributed to different sessions that received a lot of positive feedback and interesting questions from the audience. The skills training concept used within the network will be further discussed at the University of Liverpool's annual Learning and Teaching conference where the EU Project TEAM will present our first and final year training concepts.

The network is continuing to organize a large number of events for project partners and the wider laser and accelerator communities. Registration for our advanced school in Salamanca is now open and planning for a special "Scientists go industry" workshop, coordinated by our Fellows, is in the final phase. A Topical Workshop on beam diagnostics and a 3-day conference on "Laser Applications at Accelerators" will both be held on Mallorca in March 2015 and registration for these international events will open shortly. Places will be strictly limited and I recommend registering early to avoid disappointment!



Prof. Carsten P. Welsch, Coordinator

Special Interest Articles

- Research News
- Fellow Activity
- Partner News

Individual Highlights

- 3rd Topical Workshop held at HZDR
- LA³NET School open for Registration

LA³NET Workshop on Novel Acceleration Techniques Attracts Strong Audience

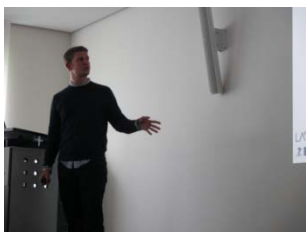
There was a huge response to the latest [LA³NET workshop on Novel Acceleration Techniques](#) demonstrating the interest this field is generating among accelerator and laser scientists. The event was hosted by the [Helmholtz Zentrum Dresden-Rossendorf](#) (HZDR) in Dresden 28th – 30th April 2014. In dedicated sessions high power laser acceleration, particle beam driven plasma wakefield acceleration and dielectric laser acceleration were all presented in detail and current challenges and future R&D plans

discussed. It was agreed that significantly more collaborative research and targeted training of early career researchers in this multi-disciplinary field is urgently required for Europe to maintain its current strong position. The 3 day workshop attracted over 60 participants including eight invited speakers and 23 contributed talks with presentations on the work achieved by four of the Fellows from LA³NET. Presentations are uploaded to be viewed on the [workshop site](#).



The delegates and speakers arriving from across Europe initially met for a relaxed reception on Sunday evening to renew old acquaintances and meet other workshop participants. The workshop proper started on Monday 28th April with introductory talks from HZDR's Scientific Director Prof. Roland Sauerbrey welcoming delegates and providing an overview of research funding in Germany along with Prof. Ulrich Schramm who went into more detail about the on-site accelerator, lasers and medical facilities. Rob Ashworth put the workshop in context in relation to LA³NET and publicised future events and activities that may be of interest to delegates. The technical talks then got underway with Peter McIntosh the technical director of STFC's ASTeC at Daresbury leading

the session on the technologies and challenges of future accelerators. Peter set the scene on the state of the art of particle acceleration to put the subsequent talks on advances in specific areas into perspective. The day continued with contributed talks from delegates before Prof. Paul Gibbon from FZ Juelich in Germany initiated the second session on laser-based ion acceleration. Paul spoke on ion acceleration using short laser pulses as an introduction to this session before delegates continued with descriptions of their latest work, particularly related to application of the science. This included the first presentation of the workshop resulting from LA³NET on laser driven ion acceleration with ultra thin targets delivered by Luca Stockhausen from CLPU.



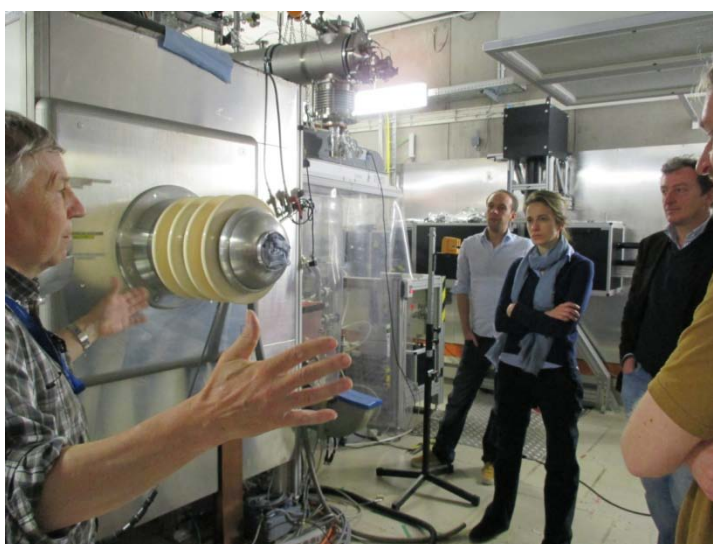
The final invited talk of the day was from Matt Zepf from HI Jena on relativistic plasma and the route to compact ultrafast particle sources.

Victor Malka from LOA started the second day of the workshop with a presentation to describe the development and demonstration of laser plasma acceleration including potential applications of this technology. This was followed by a range of delegate talks covering other aspects of novel electron acceleration including plasma ion and proton

wake field acceleration as well as plasma laser wake field.

CLPU's Andreas Doepp also spoke describing the results from his LA³NET project on Thomson backscattering experiments.

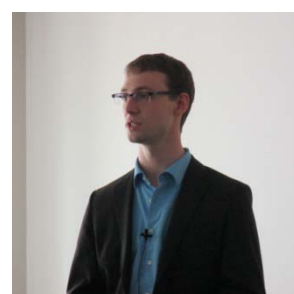
After lunch Malte Kaluza from HI Jena led the session on advanced diagnostics. The session concluded with Pengnan Lu's talk on his LA³NET project work on preparation of the SRF gun beam transport system in ELBE at HZDR.



The final day was dedicated to scientific, medical and industrial applications. Ulrich Schramm opened proceedings with a tutorial-style talk on laser-driven proton therapy in OncoRay. This was followed by a view of the market and industrial activities related to medical applications of laser ion therapy delivered by Arnd Baurichter from Danfysik. Marie Jacquet from LAL in Orsay then spoke on compact x-ray sources for clinical applications which led into the final delegate contributions of the workshop. This included Jakob Krämer, the LA³NET fellow based with Danfysik who spoke about his work on electron beam dynamics for Thomson scattering.

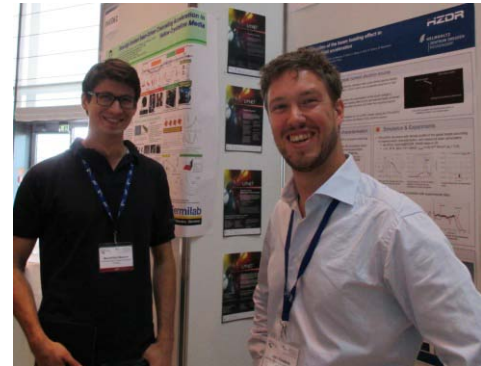
LA³NET are much obliged to HZDR for hosting the workshop. In particular, a special

thank you to Jochen Teichert and Arie Irman for developing the programme with the project steering committee and for successful implementation with strong support from Jurjen Couperus. Also, many thanks to Petra Neumann for logistics organisation which ensured the delegates were well looked after and so could concentrate their attentions on the science. This made for an appreciative audience and so the talks were well received prompting questions on the science and discussions about the future. In particular, the need for networks, events and training to establish the cross-discipline community required for this area of research.



LA³NET at IPAC 2014

LA³NET featured strongly at IPAC 2014 held in Dresden towards the end of June. Prof. Carsten Welsch presented a poster on LA³NET: Improving Ion and Electron Beam Characteristics which focussed on the research the Fellows are conducting in this area, particularly Yelong Wei, Thomas Hofmann and Cheng Chang. Andrii Borysenko also had a poster and the research covered by these Fellows is described later in the newsletter.



In addition, Jurjen Couperus from HZDR had a poster on the Investigation of the Beam Loading Effect in Laser Wakefield Acceleration and Jakob Krämer had one on the Final Focus System for Thomson Scattering at ELBE. Rob Ashworth from the EU T.E.A.M. maintaining an industry booth to showcase LA³NET disseminating information about the project, its research achievements and future events.

H2020 Design Study meeting hosted by the University of Liverpool at the Cockcroft Institute

The **European Network for Novel Accelerators (EuroNNAc)** is pushing to develop the fast-changing field of plasma wakefield acceleration. For Europe to remain competitive in science it is of crucial importance to design, build and operate world-class research infrastructures. A low repetition rate, plasma-based Free Electron Laser (FEL) would be a fantastic addition to existing facilities. EuroNNAc member institutes are planning to apply for an EU Design Study within H2020 for such a facility. In order to prepare for the Design Study Prof. Carsten Welsch and the EU Project T.E.A.M. organised a meeting of the core partners from the EuroNNAc consortium to discuss the next steps in preparing a proposal to be submitted to Horizon 2020 Infrastructures funding stream. The details of the scope of the prospective study were agreed and

responsibilities for preparing and leading the work packages were assigned at the workshop. In addition, several new technological ideas in the area of plasma acceleration are being considered and so 3 preselected applications in the H2020 programme of future emerging technologies (FET) were also discussed. For more details see indico.cern.ch/event/316901/



Train the trainers: LA³NET complementary skills training endorsed by HEA



Training in transferable skills that complement the technical research activities of post graduate researchers improves their professionalism and is essential for enhancing their employability. The complementary skills training developed by Prof. Carsten Welsch and applied in LA³NET has been adopted as part of best practice by the University of Liverpool. With further interest in the programme generated following presentations given at the national HEA Learning and Teaching Conference last year a workshop was organised by the EU Project TEAM at the Cockcroft Institute to disseminate this approach as best practice. The workshop entitled 'Enhancing the employability skills of postgraduate researchers (PGRs)' was delivered on the 11th June attracting delegates from all over the country.

The aim of the workshop was to stimulate thought and discussion about improving the effectiveness of PGR skills training by making

it more relevant for the researchers undergoing the training. The context of the requirements of employers for candidates with broad skills training was presented by Prof. Carsten Welsch along with members of the University's PGR Development Team and LA³NET project manager Dr. Rob Ashworth who spoke about implementation of the programme. The event was supported with other speakers including researchers who gave their perspective from the receiving end of the training.

In the final session contributions from delegates were encouraged and different aspects of PGR training were discussed in order to identify recommendations for best practice. This built on the lively informal discussions that had developed during the coffee and lunch breaks. A special thanks to Helen Williams for ensuring that the day ran smoothly to create an atmosphere conducive to the active participation of delegates.



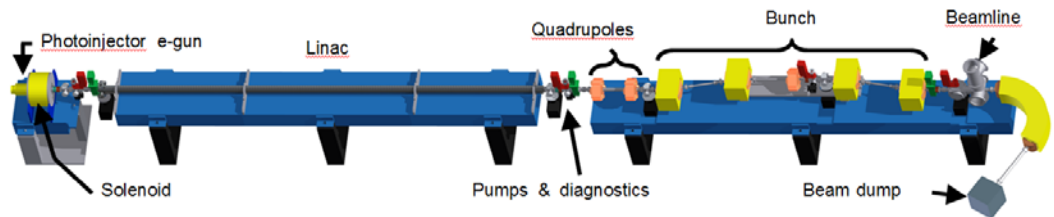
Research News from LA³NET Fellows

Andrii Borysenko: Electro-optical Bunch Length Monitor for FLUTE: Layout and Simulations



A new compact linear accelerator **FLUTE** is currently under construction at Karlsruhe Institute of Technology (KIT) in collaboration with DESY and PSI. The aim is to achieve femtosecond electron bunches ($\sim 1\text{fs} - 300\text{fs}$) with a wide charge range (1 pC - 3 nC) and requires a precise bunch length diagnostic system. This project aims at the realization and use of a high-resolution electron bunch shape detection system at FLUTE. At the current stage in the project a bunch length monitor based on the electro-optic technique is proposed. An Yb-doped fiber laser system (central wavelength 1030 nm) and a GaP crystal are considered to be main bunch

length measurement tool. For the proposed system detailed simulation studies were performed and presented within paper THPME123 at IPAC14. The main focus was to simulate electro-optical signals that would be detected using parameters specified from actual machine parameters. Important information about estimated signal shape and strength was gained and discussed. Very valuable results regarding design and location of detection system during measurements were carried out from simulation studies and will influence the final layout of the bunch length monitor.



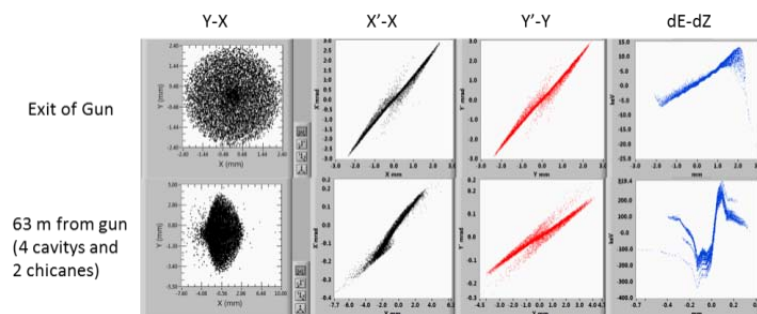
FLUTE schematic drawing.

Pengnan Lu: Simulation of the ELBE SRF Gun II



The ELBE SRF gun II is a recently developed photo injector that was installed at HZDR in Germany in May 2014 [1]. The main improvements include a new $3\frac{1}{2}$ cell fine grain Nb cavity and a super-conducting solenoid at 100 mm after the cavity. As a result, higher energy (up to 9 MeV) and improved bunch characteristics can be

expected. Further transport of the beam is expected to go through a dogleg and then the LINAC beam line of the ELBE accelerator to conduct Thomson backscattering experiments. In order to optimize beam transport complete start-to-end simulations have been realized by Fellow P. Lu at HZDR in Germany, (see picture below).



Bunch distribution and phase space of the optimized beam at the exit of the gun and after 63 m of beam transport.



First, the ASTRA simulation code was used to simulate the SRF gun output with 1D field data obtained from Superfish. After that beam transport was described using ELEGANT. A user-friendly interface was developed in Labview, linking all codes. The 6D phase space of the electron bunch at the cathode surface was based on a thermal-emission model and realistic laser pulse parameters; no other assumptions were made. To describe beam transport 3rd order

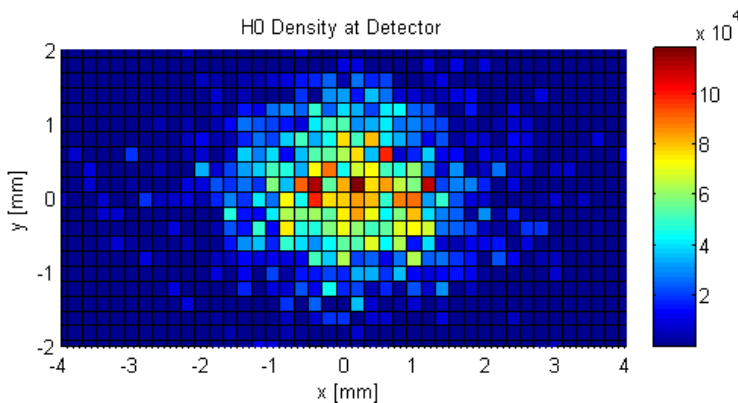
matrices were used, including effects from space charge and coherent synchrotron radiation. So far studies focused on transport of a 77 pC beam with a final energy of 47 MeV, energy spread of 150 keV and bunch length of 0.42 ps. The non-linear behaviour in longitudinal phase space shown in the picture above results from space charge effects. For further details, see [2].

Thomas Hofmann: Laser-based Emittance Meter for H⁻ Beams

The LINAC4 accelerator at CERN can accelerate H⁻ ions from 45 keV to 160 MeV. The transverse emittance is one of the key parameter for reaching higher luminosity in the LHC and needs to be measured with high accuracy. Whilst the commonly used slit-grid method provides good results at energies up to 50 MeV, the ions can no longer be efficiently stopped at higher energies and a different diagnostics approach is needed.

LA³NET Fellow Thomas Hofmann who is based at CERN in Switzerland has studied a laser system for transverse profile measurements based on photon detachment of electrons from the H⁻ ions. In his setup a pulsed laser crosses the particle beam. Since the binding energy of one electron is only 0.75 eV the detachment cross-section exceeds $3.5 \cdot 10^{-17}$

cm² in the target wavelength range. This leads to the creation of an H₀ beamlet and free electrons. By using a bending magnet and a Faraday cup one can obtain a signal proportional to the number of H⁻ ions at the position of the laser from which one can also derive the divergence of the H⁻ beam. By doing an x/y-scan with the laser the transverse emittance of the H⁻ beam can be measured. The interaction of the laser with the H⁻ ions was modelled by simulating first the photon flux of the laser. A Gaussian beam with quality factor M² was assumed for the laser, whilst a model of the particle beam was available from previous beam dynamics simulations. After a drift space the weighted particles were then integrated and an example of the simulated signal at the detector is shown in the picture below [3].



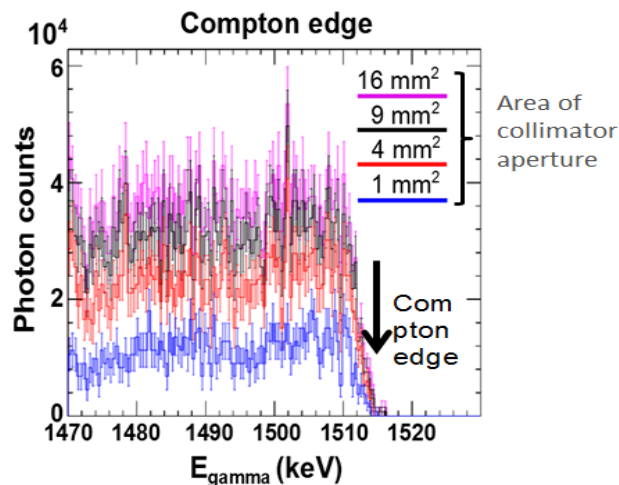
H⁰ distribution at the detector 3.5 m downstream the laser.

Cheng Chang: Beam Energy Measurements by Detection of Compton Backscattered Photons



The exact knowledge of beam energy is very important in electron accelerators. At the ANKA storage ring in Karlsruhe, Germany, the method of resonant depolarization has been used to accurately determine the energy of its 2.5 GeV electron beam. A good alternative for lower beam energies is the detection of Compton backscattered photons, generated by laser light scattered off the relativistic electron beam. In order to achieve

compactness and guarantee smooth integration into the storage ring, transverse scattering has been proposed instead of more conventional head-on collision. The transverse setup is expected to reduce the cut-off energy on the spectrum of backscattered photons by a factor of two and therefore enlarge capability of energy measurement using the same detector.



Number of photons as a function of their energy.

Feasibility studies into such monitor have been carried out by Cheng Chang and colleagues at KIT/ANKA in Germany through comparison of the resulting Compton backscattered photons as simulated with AT and CAIN 2.35 and actual measurement of background radiation with a High Purity

Germanium spectrometer [4]. The picture above illustrates the number of backscattered photons reaching the detector when a 10W CW CO₂ laser interacted with a 40 mA electron beam at low- α_c mode for 20 minutes.

- [1] P. Murcek et al., "The SRF Photoinjector at ELBE – Design and Status 2013", Proc. 16th Int. Conf. on RF Superconductivity, Paris, France (2013).
- [2] P. Lu, et al., "Simulation of the ELBA SRF GUN II", Proc. IPAC14, MOPRIO23, Dresden, Germany (2014).
- [3] S.M. Gibson, et al., "A Fibre Coupled, Low Power Laserwire Emittance Scanner at CERN LINAC4", Proc. IPAC14, THPME190, Dresden, Germany (2014).
- [4] C. Chang, et al., "Design of a Compact Setup to Determine Beam Energy by Detection of Compton Backscattered Photons at ANKA", Proc. IPAC14, Dresden, Germany (2014).

Latest Fellow Recruited

Stanimir Kisyov is to join IFIN-HH to complete the full complement of LA³NET funded fellows. More details in the next newsletter.

Fellow Activity

Outreach activity

Most fellows are now in their second year and are undertaking their outreach duties before the final year of intense activity in results collection and completion of their projects. Many are choosing to return to their home countries to deliver talks to schools including Rui Pan who visited Zhong Guan Cun School in Beijing to talk about 'Applications of Electronic Magnetic Wave in Our Normal Life' and Irene Martini who returned to her previous high school to promote the scientific career and LA³NET.



Jurjen Couperus also returned to his old school visting Raalte in the Netherlands to enlighten science students in their last year of the VWO (pre-university secondary education) who are at the point of deciding which University studies they want to enrol in. Jurjen gave a short overview of the life of a dynamic young scientist such as himself and explained the concept of PhD research and Marie Curie ITNs.

He also gave some useful pointers for the next stages of their education such as extracurricular activities (complementary skill courses provided by universities, committee/board membership), international internships and the possibility to get scholarships. Looking back, these are all things that Jurjen felt were very valuable for his personal and career development although he did not recognise it at the time. He also gave an overview of the different career paths that his friends from University took to show that there is not one fixed linear path and that there remain plenty of different flexible opportunities after first selecting a particular discipline.

Jose Luis Henares has also arranged with the principal of his former school to return there in September to give a range of talks targeted for different levels. Topics will include university studies, PhD careers and the challenges and benefits of living in another country aimed at the younger students, to more technical talks about accelerators and lasers for the upper levels.



Fellows out and about...

In May Thomas Hofmann presented a talk on his work on the laserwire emittance scanner at the CERN LINAC4 at the oPAC workshop on Beam Diagnostics. The workshop was hosted by CIVIDEC Instrumentation GmbH in Vienna and is the third in the series of oPAC topical workshops.



Fellows' Workshop - Scientists Go Industry

To satisfy society's needs science and industry must complement each other. Therefore, the fellows of LA³NET specialized in laser and accelerator physics, are aiming to bring both communities together in this workshop. Through a combination of talks from industry speakers, poster and discussion sessions, the aim is to comprehensively explore the corporate and industry career opportunities open to young postgraduate and post-doctorate scientists in the laser and accelerator physics field. This event will be open to young researchers, both from within LA³NET and from the wider scientific community.

It will be hosted by the Helmholtz Association, Berlin 17th-18th November 2014. Further details will be available nearer the time on the LA³NET website and registration will be open between 7th July 2014 and 17th October 2014.

LA³NET
Scientists go Industry
Berlin, Helmholtz Association
17-18 November 2014

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Registration:
Between 7 July 2014 and 17 October 2014.
Scholarships for young researchers will be available.
For further details on the LA³NET project and events:
www.la3net.eu

Partners:

This project has received funding from the European Union's Horizon Research Programme for research, technological development and innovation under grant agreement no. 260102

Partner News

Polytechnic University of Milan join LA³NET

The latest addition to LA³NET is the Polytechnic University of Milan who have joined as an adjunct partner and already participated in the network activities making a valuable contribution to the recent workshop on Novel Acceleration Techniques held at HZDR. The University's Physics Department has much experience in the laser field and the Department of Energy hosts other relevant expertise such as solid state physics, surface science and plasma physics which are aimed at either the understanding

of fundamental physical phenomena or the development of technological applications. The main focus is on synthesis and investigation of novel materials with energy applications such as solar cells and nuclear engineering currently being investigated. In this frame, research on the interaction of ultraintense laser beams with matter, with particular relevance to novel laser-based ion acceleration schemes, is also carried out. [More information.](#)



Vacancies in the Network

The newly created position at GANIL for an early stage researcher to work on the 'Study of resonant laser ionization in the REGLIS low energy branch of the S3 spectrometer at SPIRAL2-GANIL' is still open.

For more details on how to apply visit the website www.liv.ac.uk/la3net/vacancies/



Upcoming Events

Register for the School on Laser Applications at Accelerators at CLPU

Places for the 3rd LA³NET School on Laser Applications at Accelerator are quickly being booked. The Centre for Ultrashort, Ultraintense Pulsed Lasers (CLPU) will host the School at the University of Salamanca from 29th September to 3rd October 2014. In addition to lectures about the applications of lasers for accelerator operation there will be study groups, a poster session with industry displays, an interactive panel session and evening seminars. There will also be opportunities for discussion and networking during a tour of the CLPU facilities and at evening events.

Recognized specialists from outside the network will be engaged to complement partner expertise to cover topics such as:

- Introduction to lasers, accelerators and FELs
- Laser ion, electron and x-ray sources,
- Laser acceleration,
- Laser based beam diagnostics,
- Industrial applications.

For more information and to register go to www.liv.ac.uk/la3net/events/schools/...



7th International Conference on Laser Probing LAP2015

National Superconducting Cyclotron Laboratory (NSCL) and Facility for Rare Isotope Beams (FRIB) at Michigan State University will host the 7th International Conference on Laser Probing (LAP2015) on June 7-10, 2015 in East Lansing, MI. The conference is aimed to highlight the state of the art in Laser Probing, including: optical spectroscopy of atoms and molecules; analysis and characterization of solid, fluid and gaseous materials and particles; reaction

chemistry and ultrafast phenomena; development of new laser-based techniques; nuclear structure and interactions; and, facilities and instrumentation. LAP2015 is also aimed to reinforce the common ground and synergies among the different actors in the field with an expected 100 attendees.

<http://meetings.nscl.msu.edu/lap2015/>

Joke Box

If you were driving your car at the speed of light and you turned the headlights on would anything happen?

Talking of cars, Erwin Schrödinger was happily driving along when the police pulled him over to the side of the road. He was accused of driving erratically and asked to remain in the vehicle while it was searched. After a few moments the officer approached him again and asked, 'Did you know there is a dead cat in the boot?' 'There is now,' he replied.



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LA³NET Events

Sept 22 nd -26 th 2014	School on Advanced Laser Applications at Accelerators, CLPU at the University of Salamanca, Spain
Nov 17 th -18 th 2014	Scientists Go Industry, Berlin, Germany
March 23 rd -24 th 2015	Beam diagnostics workshop, Mallorca, Spain
March 25 th -27 th 2015	LA ³ NET Conference, Mallorca, Spain
June 26 th 2015	Symposium on Accelerators for Science & Society, Convention Centre, Liverpool, UK

Other Events

July 7 th -11 th 2014	oPAC Accelerator School, Royal Holloway University of London, UK
Aug 25 th – 29 th 2014	FEL 2014, Basel, Switzerland
Aug 31 st – Sept 12 th 2014	Introduction to accelerator physics, CAS & CTUP, Prague, Czech Republic
Sept 1 st –5 th 2014	Linac14, Geneva, Switzerland

NOTICE BOARD

Host institutions and principal investigators must acknowledge the support received when any data or achievements resulting from research funded by the European Union are communicated such as in journals, patents, presentations, etc. The European flag emblem must be included along with the following statement:

'This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 289191.'

The Marie Curie and FP7 Logos shall no longer be used !

DEADLINE FOR THE NEXT NEWSLETTER: 12. September 2014.

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 centers, universities and industry partners from across Europe will develop beyond-state-of-the-art techniques and technologies through a joint inter-sectorial training program for early stage researchers within a unique European partnership.

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 289191.



www.la3net.eu

