Newsletter
March 2016
Issue 15

2016 – An eventful year has started

Following the unanimous decision of the Steering Committee to continue all core LA³NET activities, the planning of events in 2016 has progressed very well. We will organize a Fellow reunion in Krakow, Poland between 26-28 June which will give us the opportunity to talk about the different experiences made after the network came to its official end. Former Fellows from our sister network oPAC will also be invited to join the event and a visit to the brand-new Solaris light source will also be part of the reunion. On Monday 27 June we will hold a *Workshop on Researcher Careers* which will also be open to local PhD students and Postdocs. Invited speakers from across Europe will talk about the exciting career prospects in academia, industry and at (inter)national research centres which shall help in the long term career planning. We will also talk about commonly faced challenges such as contributions into health insurance and pension schemes as part of international mobility. I already look forward to seeing our wonderful Fellows again.

LA³NET goes IPAC. The International Particle Accelerator Conference (IPAC) will this year take place in Busan, South Korea. The network will be represented via an industry stand where Magda and I will showcase the many achievements of our Fellows, their research papers, our final project brochure and also present upcoming research and training opportunities through the brand-new OMA project. We would like to bring all former LA³NET Fellows attending the conference together – so if you plan to attend IPAC, please get in touch with us so we can make all necessary arrangements.

The H2020 Design Study EuPRAXIA is now running at full speed. Following a dynamic kickoff meeting in Hamburg, the Management Committee has recently met in Paris to discuss further plans. Amongst others a *Workshop on a European Plasma Accelerator with Excellence in Applications* will now be held in Pisa, Italy between June 29 – July 1. A lot of the EuPRAXIA R&D is closely linked to what we covered within LA³NET and I am sure that many network partners will participate to this event. Registration has just opened and can be accessed via a dedicated indico page.

LA³NET will continue to organize its own events. I am delighted to announce two Topical Workshops that will build up on the successful scheme developed over the past four years. *Laser Ion Sources* will be targeted on 24-25. October whilst the field of *Novel Accelerators* will be covered 24-26. October 2016. Both events will take place in Paris, France and registration will open early in April. Full information as usual via our project website.

Prof. Carsten P. Welsch, Coordinator

Research News

Nuclear Instruments and Methods in Physics Research A publications crown the LA³NET International Conference on Laser Applications at Accelerators

The International Conference on Laser Applications at Accelerators - LA³NET 2015 was held in Mallorca in March 2015. The Conference was the culmination of a series of technical schools and topical workshops delivered by the LA³NET project and brought together around 70 researchers from the laser and particle accelerator communities.
Following the standard peer review nine articles building up on conference contributions have now been published in Nuclear Instruments and Methods in Physics Research A, with another ten published last year in a special issue of Physics Procedia, already mentioned in our previous newsletter.

Below are the abstracts from the LA³NET Fellows' papers published in Nuclear Instruments and Methods A.

'Laser diode self-mixing technique for liquid velocimetry', *A. Alexandrova*, C.P. Welsch, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2015.12.042

Abstract:
Using the self-mixing technique, or optical feedback interferometry, fluid velocity measurements of water seeded with titanium dioxide have been performed using a laser diode to measure the effect of the seeding particle concentration and also the pump speed of the flow. The velocimeter utilises commercially available laser diodes with a built-in photodiode for detection of the self-mixing effect. The device has demonstrated an accuracy better than 10% for liquid flow velocities up to 1.5 m/s with a concentration of scattering particles in the range of 0.8–0.03%. This is an improvement of one order of magnitude compared to previous experiments. The proposed velocimeter is to be developed further for application in gas-jet measurements.

'Tomographic characterisation of gas-jet targets for Laser Wakefield Acceleration', *J.P. Couperus*, A. Köhler, T.A.W. Wolterink, A. Jochmann, O. Zarini, H.M.J. Bastiaens, K.J. Boller, A. Irman, U. Schramm, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2016.02.099

Abstract:
Laser wakefield acceleration (LWFA) has emerged as a promising concept for the next generation of high energy electron accelerators. The acceleration medium is provided by a target that creates a local well-defined gas-density profile inside a vacuum vessel. Target development and analysis of the resulting gas-density profiles is an important aspect in the further development of LWFA.
Gas-jet targets are widely used in regimes where relatively high electron densities over short interaction lengths are required (up to several millimetres interaction length, plasma densities down to). In this paper we report a precise characterisation of such gas-jet targets by a laser interferometry technique. We show that phase shifts down to 4 mrad can be resolved. Tomographic phase reconstruction enables detection of non-axisymmetrical gas-density profiles which indicates defects in cylindrical nozzles, analysis of slit-nozzles and nozzles with an induced shock-wave density step. In a direct comparison between argon and helium jets we show that it cannot automatically be assumed, as is often done, that a nozzle measured with argon will provide the same gas density with helium.

'A bremsstrahlung gamma-ray source based on stable ionization injection of electrons into a laser wakefield accelerator', *A. Döpp*, E. Guillaume, C. Thaury, A. Lifschitz, F. Sylla, J-P. Goddet, A. Tafzi, G. Iaquanello, T. Lefrou, P. Rousseau, E. Conejero, C. Ruiz, K. Ta Phuoc, V. Malka, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2016.01.086

Abstract:
Laser wakefield acceleration permits the generation of ultra-short, high-brightness relativistic electron beams on a millimeter scale. While those features are of interest for many applications, the source remains constraint by the poor stability of the electron injection process. Here we present results on injection and acceleration of electrons in pure nitrogen and argon. We observe stable, continuous ionization-induced injection of electrons into the wakefield for laser powers exceeding a threshold of 7 TW. The beam charge scales approximately with the laser energy and is limited by beam loading. For 40 TW laser pulses we measure a maximum charge of almost 1 nC per shot, originating mostly from electrons of less than 10 MeV energy. The relatively low energy, the high charge and its stability make this source well-suited for applications such as non-destructive testing. Hence, we demonstrate the production of energetic radiation via bremsstrahlung conversion at 1 Hz repetition rate. In accordance with Geant4 Monte-Carlo simulations, we measure a γ-ray source size of less than 100 µm for a 0.5 mm tantalum converter placed at 2 mm from the accelerator exit. Furthermore we present radiographs of image quality indicators.

'Laser resonance ionization scheme development for tellurium and germanium at the dual Ti:Sa–Dye ISOLDE RILIS', *T. Day Goodacre*, D. Fedorov, V.N. Fedosseev, L. Forster, B.A. Marsh, R.E. Rossel, S. Rothe, *M. Veinhard*, Nucl. Instr. Meth. A (2015), doi:10.1016/j.nima.2015.10.066

Abstract:
The resonance ionization laser ion source (RILIS) is the principal ion source of the ISOLDE radioactive beam facility based at CERN. Using the method of in-source laser resonance ionization spectroscopy, a transition to a new autoionizing state of tellurium was discovered and applied as part of a three-step, three-resonance, photo-ionization scheme. In a second study, a three-step, two-resonance, photo-ionization scheme for germanium was developed and the ionization efficiency was measured at ISOLDE. This work increases the range of ISOLDE RILIS ionized beams to 31 elements. Details of the spectroscopy studies are described and the new ionization schemes are summarized.

'Hot-cavity studies for the Resonance Ionization Laser Ion Source', *J.L. Henares*, N. Lecesne, *L. Hijazi*, B. Bastin, T. Kron, J. Lassen, F. Le Blanc, R. Leroy, B. Osmond, S. Raeder, F. Schneider, K. Wendt, Nucl. Instr. Meth. A (2015), doi:10.1016/j.nima.2015.10.061

Abstract:
The Resonance Ionization Laser Ion Source (RILIS) has emerged as an important technique in many Radioactive Ion Beam (RIB) facilities for its reliability, and ability to ionize target elements efficiently and element selectively. GISELE is an off-line RILIS test bench to study the implementation of an on-line laser ion source at the GANIL separator facility. The aim of this project is to determine the best technical solution which combines high selectivity and ionization efficiency with small ion beam emittance and stable long term operation. The ion source geometry was tested in several configurations in order to find a solution with optimal ionization efficiency and beam emittance. Furthermore, a low work function material was tested to reduce the contaminants and molecular sidebands generated inside the ion source. First results with ZrC ionizer tubes will be presented. Furthermore, a method to measure the energy distribution of the ion beam as a function of the time of flight will be discussed.

'Experimental results of the laserwire emittance scanner for LINAC4 at CERN', *Thomas Hofmann*, Gary E. Boorman, Alessio Bosco, Enrico Bravin, Stephen M. Gibson, Konstantin O. Kruchinin, Uli Raich, Federico Roncarolo, Francesca Zocca, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2016.02.018

Abstract:
Within the framework of the LHC Injector Upgrade (LIU), the new LINAC4 is currently being commissioned to replace the existing LINAC2 proton source at CERN. After the expected completion at the end of 2016, the LINAC4 will accelerate H− ions to 160 MeV. To measure the transverse emittance of the H− beam, a method based on photo-detachment is proposed. This system will operate using a pulsed laser with light delivered via an optical fibre and subsequently focused onto the H− beam. The laser photons have sufficient energy to detach the outer electron and create H0/e− pairs. In a downstream dipole, the created H0 particles are separated from the unstripped H− ions and their distribution is measured with a dedicated detector. By scanning the focused laser beam across the H− beam, the transverse emittance of the H− beam can be reconstructed. This paper will first discuss the concept, design and simulations of the laser emittance scanner and then present results from a prototype system used during the 12 MeV commissioning of the LINAC4.

'Electron beam final focus system for Thomson scattering at ELBE', *J.M. Krämer*, M. Budde, F. Bødker, A. Irman, A. Jochmann, J.P. Kristensen, U. Lehnert, P. Michel, U. Schramm, Nucl. Instr. Meth. A (2015), doi:10.1016/j.nima.2015.10.067

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Abstract:
The design of an electron beam final focus system (FFS) aiming for high-flux laser-Thomson backscattering X-ray sources at ELBE is presented. A telescope system consisting of four permanent magnet based quadrupoles was found to have significantly less chromatic aberrations than a quadrupole doublet or triplet as commonly used. Focusing properties like the position of the focal plane and the spot size are retained for electron beam energies between 20 and 30 MeV by adjusting the position of the quadrupoles individually on a motorized stage. The desired ultra-short electron bunches require an increased relative energy spread up to a few percent and, thus, second order chromatic effects must be taken into account. We also present the design and test results of the permanent magnet quadrupoles. Adjustable shunts allow for correction of the field strength and compensation of deviations in the permanent magnet material.

For a beam emittance of 13 mm mrad, we predict focal spot sizes of about 40 µm (rms) and divergences of about 10 mrad using the FFS.

'Coulomb field strength measurement by electro-optic spectral decoding system at the CALIFES beam line', *R. Pan*, S.P. Jamison, T. Lefevre, W.A. Gillespie, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2016.03.043

Science & Technology Facilities Council

Abstract:
Electro-optic (EO) techniques are increasingly used for longitudinal bunch profile measurements. A bunch profile monitor, based on electro-optic spectral decoding (EOSD), has been developed and demonstrated on the CALIFES beam line at CERN. The EO response is analysed using a frequency domain description, and two methods for extraction of absolute Coulomb field strengths from the electron bunch are demonstrated. Measurements at field strengths up to 1.3 MV/m agree with the expectation based on independent charge measurements.

'Simulations of radiation pressure ion acceleration with the VEGA Petawatt laser', *Luca C. Stockhausen*, Ricardo Torres, Enrique Conejero Jarque, Nucl. Instr. Meth. A (2015), doi:10.1016/j.nima.2015.10.068

Abstract:
The Spanish Pulsed Laser Centre (CLPU) is a new high-power laser facility for users. Its main system, VEGA, is a CPA Ti:Sapphire laser which, in its final phase, will be able to reach Petawatt peak powers in pulses of 30 fs with a pulse contrast of $1{:}10^{10}$ at 1 ps. The extremely low level of pre-pulse intensity makes this system ideally suited for studying the laser interaction with ultrathin targets. We have used the particle-in-cell (PIC) code OSIRIS to carry out 2D simulations of the acceleration of ions from ultrathin solid targets under the unique conditions provided by VEGA, with laser intensities up to 10^{22} W cm^{-2} impinging normally on thick overdense plasmas, with different polarizations and pre-plasma scale lengths. We show how signatures of the radiation pressure-dominated regime, such as layer compression and bunch formation, are only present with circular polarization. By passively shaping the density gradient of the plasma, we demonstrate an enhancement in peak energy up to tens of MeV and monoenergetic features. On the contrary linear polarization at the same intensity level causes the target to blow up, resulting in much lower energies and broader spectra. One limiting factor of Radiation Pressure Acceleration is the development of Rayleigh–Taylor like instabilities at the interface of the plasma and photon fluid. This results in the formation of bubbles in the spatial profile of laser-accelerated proton beams. These structures were previously evidenced both experimentally and theoretically. We have performed 2D simulations to characterize this bubble-like structure and report on the dependency on laser and target parameters.

LA³NET and oPAC Fellows use Lightsaber to Diagnose Particle Beam

LA³NET Fellow Thomas Hoffmann (CERN) and oPAC Fellow Konstantin Kruchinin (Royal Holloway University of London) have published their research results on the use of a laserwire scanner for the CERN Linac4 beam in the journal Physical Review Special Topics: Accelerators and Beams.

The laser wire can simply cut through a beam of negatively charged H- ions and is able to precisely measure the beam's profile and even emittance – a crucial parameter in any particle beam. Thomas and Konstantin joined forces with colleagues from CERN and the UK and successfully measured the distribution of photo-neutralized particles. This allowed them to reconstruct the transverse emittance of the beam. In particular they managed to characterize the vertical phase-space distribution of a 3 MeV beam during the commissioning of the LINAC4 accelerator.

Thomas, who led the study, commented: "We have compared our results to data obtained with a commonly used slit and grid method and found a very good agreement. The beauty of our method is that we hardly disturb the beam. We have developed a truly non-invasive measurement alternative and have shown that it is working extremely well."

Prof. Carsten Welsch from the Cockcroft Institute/University of Liverpool who coordinates both the LA³NET and oPAC projects added: "It is a pleasure to see this excellent work as a result from collaboration between two of Europe's largest research networks. Using laser beams for beam diagnostic and acceleration purposes has been a focus within these R&D projects. They were also successfully applied for precision velocimetry and to generate strong forces for highest gradient beam acceleration in high power and dielectric laser acceleration." These promising results will now form the basis for follow-on R&D projects.

'Demonstration of a laserwire emittance scanner for hydrogen ion beams at CERN', *T. Hofmann*, K. O. Kruchinin, A. Bosco, S. M. Gibson, F. Roncarolo, G. Boorman, U. Raich, E. Bravin, J. K. Pozimski, A. Letchford, C. Gabor, Phys. Rev. ST Accel. Beams 18, 122801 (2015) (18.122801)

University of Strathclyde's Partnership in LA³NET bears fruit

Luca Stockhausen participates in the work 'Ion acceleration and plasma jet formation in ultra-thin foils undergoing expansion and relativistic transparency' published in the Nuclear Instruments and Methods in Physics Research Section A. The team of researchers, led by Prof. Paul McKenna from the University of Strathclyde, have managed to distinguish three distinct ion acceleration mechanisms in the interaction of an intense laser pulse with an ultrathin foil target. The experiment was performed in the Rutherford Appleton Laboratory (UK) using the Vulcan petawatt laser.

When the laser impinged on the target at an oblique angle, three distinct components were observed in the spatial-intensity profile of the proton beams, which had characteristic signatures of different ion acceleration mechanisms: Target Normal Sheath Acceleration, Radiation Pressure Acceleration, and acceleration enhanced by Relativistic Induced Transparency. In the latter, a plasma jet is generated that extends into the expanding ion population. The electrons in this jet are directly accelerated to higher energy by the laser pulse and couple additional energy to a local region of the sheath-accelerated proton distribution, enhancing both the flux and maximum energy of the protons in this region.

The effect of the laser incidence angle on the characteristics of the plasma jet was also investigated, and the phenomena observed experimentally were reproduced by 2D and 3D PIC simulations, supporting the above mentioned interpretation.

'Ion acceleration and plasma jet formation in ultra-thin foils undergoing expansion and relativistic transparency', M. King, R.J. Gray, H.W. Powell, D.A. MacLellan, B. Gonzalez-Izquierdo, *L.C. Stockhausen*, G.S. Hicks, N.P. Dover, D.R. Rusby, D.C. Carroll, H. Padda, R. Torres, S. Kar, R.J. Clarke, I.O. Musgrave, Z. Najmudin, M. Borghesi, D. Neely, P. McKenna, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2016.02.032

Network News

LA^{3}NET presented at Photoptics 2016 in Rome

Former LA^{3}NET Fellow Alexandra Alexandrova, from the University of Liverpool and the Cockcroft Institute, participated in the 4th International Conference on Photoptics, Optics and Laser Technology, Photoptics 2016. The conference took place in Rome, Italy, between 27th-29th February. The event featured the latest trends in optics, photonics and lasers and their use and impact on modern society. This includes medical applications, space exploration, telecommunications and information technology. Presentations and posters covered both theoretical and practical aspects of on-going research from all over the world, thus highlighting the wide range of novel R&D within the field. Ms. Alexandrova was specifically invited to talk about the scientific achievements and training vision of LA^{3}NET.

This provided her with an opportunity to present a summary of the main research results of our highly successful network and at the same time illustrate the many areas where the laser and accelerator communities can efficiently work together. She also presented her recently founded company D-Beam as one result from this international training initiative.

Capitalising on LA^{3}NET Skills Training

Building on the experience of the LA^{3}NET complementary skills training program a similar training was provided recently to the first-year postgraduate students from the University of Liverpool's School of Physical Sciences.

During the four days' workshop Prof. Carsten Welsch (LA^{3}NET Coordinator) and Magda Klimontowska (LA^{3}NET Project Manager) together with Dr. Dave Joss and Dr Shirley Cooper from the University of Liverpool introduced the students to such topics as presentation skills, project management, scientific writing and peer review. Part of the workshop was built around independent team work - the participants divided into four groups prepared outreach project proposals which they then presented to other groups and the tutor panel for evaluation. The students came up with some novel and exciting outreach ideas that could be applied in real life in the future.

The workshop provided an excellent opportunity to develop skills that will be valuable for the students in their research career and the positive feedback proved that the participants found the training and advice from the tutors very useful.

LA³NET Events

Stay tuned

The LA³NET project activities for 2016 include a Researcher Careers Workshop – Fellows Reunion as well as two Topical Workshops.

Researcher Careers Workshop - Fellows Reunion
This will take place in Krakow, Poland with the Careers Workshop on Monday 27th June 2016 open also to external participants.
For the LA³NET and oPAC Fellows there will be satellite events on the Sunday afternoon 26th June and Tuesday morning 28th June, including a visit to the Solaris synchrotron.
Registration via an indico page will be open soon and will be accessible through the project home page.

Topical Workshops:

Laser Ion Source Workshop	**24-25 October 2016, Paris, France.**
Novel Accelerators Workshop	**24-26 October 2016, Paris, France.**

More details will be announced via the LA³NET website soon!

Upcoming Event

IPAC'16 in South Korea

LA³NET will be present once again at the International Particle Accelerator Conference (IPAC) which takes place this year in Busan (South Korea), from 8th to 13th May.
LA³NET project manager Magda Klimontowska and fellow manager Dr. Ricardo Torres from the oPAC project will promote the work of our fellows at the industrial exhibition.

If you are attending IPAC, please visit us at Booth 146!

Fellows News

Doctorate Degrees awarded to LA^{3}NET Fellows

Congratulations to Jose Luis Henares, Irene Martini and Cheng Chang!

Jose Luis Henares, LA^{3}NET Fellow hosted by GANIL (France) has been awarded the doctoral degree from the University of Caen.

In his doctoral thesis the now Dr. Henares presents the development of a Resonant Ionization Laser Ion Source (RILIS) at GANIL facility. RILIS is a selective ion source technique which is based on a step-wise resonant excitation process where the elements of interest are ionized via atomic resonant excitation by laser radiation. The off-line RILIS test bench at GANIL consists of three tunable titanium:sapphire lasers and a hot-cavity ion source. In this work a new three-step Zn ionization scheme was developed and the already known ionization schemes for Sn have been compared in order to identify the best ionization scheme for titanium:sapphire laser systems. Furthermore, several configurations of the ion source geometry were tested (two diameters and two lengths) in order to provide an optimal ionization efficiency and ion beam emittance. An increasing of the ionizer diameter was found to enhance the production of laser ionizer elements, while no enhancement was observed by modifying the ionizer length. The time-of-flight of the generated ions was also studied for the different ion source configurations at several temperatures. In addition, a technique to measure the convolution of the spatial and energetic spread of the ion bunches at the detection point was developed. Finally, two contamination reduction techniques were studied: Firstly, the ions trajectories through the ion source cavity can be modified by the electric field generated due to resistive heating. Therefore, a study of the appropriate configuration of the electric field direction was performed to reduce the alkali contamination of the ion beam. Secondly, a low work function material was tested in order to reduce the production of alkali contaminants and molecular sidebands generated inside the ion source.

Irene Martini, LA³NET Fellow hosted by CERN, successfully defended her PhD on the 19th of February at Politecnico di Milano. Her thesis on *Characterization of Cs-Sb chatodes for high charge RF photoinjectors* raised the interest of the final exam committee members who asked a number of questions.
The main goal of Irene's PhD thesis is to provide a comprehensive experimental investigation of the use of this delicate material for photoinjector applications. The experimental activities, devoted to asses the feasibility of producing high quality Cs3Sb cathodes, include production by thin film deposition and characterization of the photoemissive properties in a DC gun beam line. The performance of Cs-Sb photocathodes was tested in a high charge RF photoinjector setup allowing to measure their main features. X-ray photoelectron spectroscopy analyses were used to correlate the measured photoemissive properties with the cathode composition as well as to investigate the cathode deterioration observed during operation. A close comparison with the Cs2Te cathodes performance is also discussed. The study of Dr. Martini represents a step forward in the development of photocathodes for applications in high charge RF photoinjectors, providing a valuable characterization of the Cs-Sb photocathode performance.

Irene is happy to share this news with the LA³NET community and she would like to acknowledge the support she has received during the 3 years of her research project.

Cheng Chang has been recently awarded a PhD degree as a result of successful defence of the thesis on *Precise determination of electron beam energy with Compton backscattered laser photons at ANKA,* based on his work developed at KIT, Germany.

ANKA (Angströmquelle Karlsruhe) is a third generation light source, providing users synchrotron radiation from the far-infrared to hard X-rays. Its operation energy is from 0.5 GeV to 2.5 GeV. Since 2004 short bunch operation using ultra-low momentum compaction factor at 1.3 GeV and 1.6 GeV has been provided for THz radiation research. Previously, the method of resonant spin depolarization was used to accurately determine the energy and the momentum compaction factor at 2.5 GeV of the ANKA electron storage ring. However, this method becomes cumbersome or even unrealistic for lower energies, especially for the short bunch operation, since the build-up time of the polarized electron beam becomes extremely long. Therefore an innovative method based on Compton backscattering has been developed to accurately calibrate the entire energy range of ANKA storage ring with typical relative uncertainties of a few 10^{-4}. Especially the nonlinear momentum compaction factors at short bunch operation have also been determined precisely.

The theoretical model, numerical studies, design and implementation of the respective sub-system and component, the measurement procedure as well as the measurement results are presented in Dr. Chang thesis. The possibilities of the setup adaption to other facilities have also been explored and included.

LA³NET Fellows leave the Nest

Our Fellows choose varied career paths after their LA³NET projects have finished: some decide to continue research in academia while others take up positions in industry or start their own companies.

Mateusz Tyrk has recently started a new job as an Optics Application Engineer in PowerPhotonic ltd. in Scotland. He will now be responsible not only for technological design, but also for identifying the markets and customers for the products developed. PowerPhotonic is a global leader in the design and manufacture of precision micro-optics for laser applications. It's also a pioneer in the use of laser micro-machining for the manufacturing of precision micro-optics products.

In parallel Matt, who for the last three years was hosted by the University of Dundee, is working on his PhD thesis that he plans to submit soon.

Alexandra Alexandrova has decided to explore the opportunity to commercialise the projects she worked on as an LA³NET Fellow and Quasar group member and she recently established the ltd company *D-Beam* together with Prof. Carsten Welsch. *D-Beam ltd* provides optical diagnostics which have been developed as reliable and cost-efficient techniques for use at accelerator and clinical facilities, light sources, and reactors, i.e. for application in research, healthcare, security, environment and manufacture.

D-Beam ltd covers the design, manufacture, installation and operation of advanced diagnostics for beam characterisation, loss detection and radiation protection applications in storage rings, linear accelerators, and experimental zones. This includes self-mixing laser diode sensors for displacement, vibration and velocity measurements, light transport systems based on optical fibres that help overcome the limitations of lens-based systems, custom-designed radiators for particle detection and beam loss monitoring applications, as well as modelling of the expected signal output from various photo sensors, including Silicon Photo Multipliers (SiPMs), Photo Multiplier Tubes (PMTs) or Avalanche Photo Diodes (APDs).

Further details about the company and its offer: http://www.d-beam.co.uk/

In the Classroom

One of the aims of Marie Curie ITN projects is to attract young people to science. LA³NET Fellows have carried out a number of school visits and met with children of different age and from different countries to introduce them to science and the life of a scientist.

Yelong Wei recently visited St. Philip Westbrook Primary school to share his passion for science with children.
In his talk 'Science and our Life' Yelong presented to little students how science affects our everyday life, even the routine activities. Afterwards he carried out demonstrations using a plasma ball and a magnetic accelerator. The demonstrations created a lot of interest and excitement among the pupils and triggered many questions. The positive feedback shows that the children and teachers enjoyed the event and found it very useful.

Partner News

2016 – a LEAP Year

Since 1990 the LEAP (Low Energy Antiproton Physics) conference is held every two or three years to discuss the latest findings and exchange information about research with low energy antiprotons.
There has been some remarkable progress recently in experiments with low energy antiproton physics and new facilities such as the Extra Low Energy Antiproton Ring (ELENA) or the Facility for Low energy Antiproton and Ion Research (FLAIR) will offer even more exciting prospects for hitherto impossible experiments. Between 6th – 11th March 2016 the world's experts in this exciting research area met in the beautiful town of Kanazawa, Japan. They discussed the latest findings in antiproton physics and related fields. They also talked about future experiments and how to take maximum benefit from the improved beam quality that new facilities can provide.

The scientific program consisted of invited and contributed talks which allowed research leaders to present their latest findings. Poster sessions during the first two days allowed for further discussion.

Advanced diagnostics as they have been developed as part of the LA³NET project is key also for antimatter facilities. The University of Liverpool / Cockcroft Institute researchers contributed to both poster sessions and talks. Marie Curie Senior Fellow Dr. Javier Resta-Lopez presented a poster on *"beam dynamics studies and design optimisation of new low energy antiproton facilities"* and PhD candidate James Hunt triggered many interesting discussions with a poster on *"beam quality measurements for low energy antiproton machines"*. This is an interesting method to characterize the stored antiproton beam that shall be implemented in ELENA later this year. Finally, LA³NET coordinator Prof. Carsten P. Welsch gave a talk about *"beam diagnostics for low energy antiprotons"*.

£3 Million European Training Network for Particle Beam Cancer Therapy launched

The Optimization of Medical Accelerators (OMA) started officially on 1 February 2016.

OMA is an international collaboration of 31 institutions which during the four year project duration will train 15 early stage researchers in the field of particle beam therapy for cancer treatment.

All project partners gathered for the Kick-off Meeting organized on 24th – 26th February at the University of Liverpool which also leads the project from the Cockcroft Institute. The research leaders presented summaries of their anticipated contributions and details about their research projects.

The meeting was chaired by the network coordinator, Prof. Carsten P. Welsch, who together with his dedicated EU TEAM introduced the partners to the specific rules and regulations of the Horizon 2020 framework, the project time plan, milestones and deliverables, planned project events and the network wide communication and outreach plans. He said: "We had a very positive atmosphere during the entire meeting and many fruitful discussions around research projects, fellows' recruitment and training events. All partners are looking forward to the many opportunities OMA will provide."

OMA will train 15 early stage researchers to carry out research into treatment facility design, numerical simulations for the development of advanced therapies and novel imaging and beam diagnostic techniques.

There are still some fellowship positions available within the network, with a deadline for application 30th April 2016. For details please check the OMA website: http://www.oma-project.eu/

Vacancies

Vacancies within the QUASAR Group at the University of Liverpool / Cockcroft Institute

Postdoc Opportunities

The High Luminosity (HL) upgrade of the Large Hadron Collider (LHC) at CERN requires advanced beam simulation studies as well as innovative diagnostics techniques to fully exploit the machine performance. We have two position vacancies that will look into longitudinal and transverse beam motion, as well as least-invasive diagnostics for the primary HL-LHC beam.

Fellowship Opportunities

We invite expressions of interest for a number of prestigious Fellowships and grants, including ERC Starting and Consolidator Grants, Marie Curie Fellowships, and STFC Rutherford Fellowships all year around.

These funding schemes offer outstanding supporting and developing opportunities for time frames between 2-5 years and are an ideal platform for those who have already demonstrated their potential as outstanding researchers. We can provide access to world-class research infrastructures and help you develop your proposal into a competitive bid.

If you are interested in further details, please do not hesitate to contact Prof. Carsten Welsch at carsten.welsch@cockcroft.ac.uk

Other Vacancies

Marie Curie Early Stage Career Fellowship – OMA project
Several locations around Europe

Joke Box

Two theoretical physicists are lost at the top of a mountain. Theoretical physicist No 1 pulls out a map and peruses it for a while. Then he turns to theoretical physicist No 2 and says:

"Hey, I've figured it out. I know where we are."
"Where are we then?"
"Do you see that mountain over there?"
"Yes."
"Well… THAT'S where we are."

Selected Publications

'Laser diode self-mixing technique for liquid velocimetry', *A. Alexandrova*, C.P. Welsch, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2015.12.042

'Tomographic characterisation of gas-jet targets for Laser Wakefield Acceleration', *J.P. Couperus*, A. Köhler, T.A.W. Wolterink, A. Jochmann, O. Zarini, H.M.J. Bastiaens, K.J. Boller, A. Irman, U. Schramm, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2016.02.099

'A bremsstrahlung gamma-ray source based on stable ionization injection of electrons into a laser wakefield accelerator', *A. Döpp*, E. Guillaume, C. Thaury, A. Lifschitz, F. Sylla, J-P. Goddet, A. Tafzi, G. Iaquanello, T. Lefrou, P. Rousseau, E. Conejero, C. Ruiz, K. Ta Phuoc, V. Malka, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2016.01.086

'Laser resonance ionization scheme development for tellurium and germanium at the dual Ti:Sa–Dye ISOLDE RILIS', *T. Day Goodacre*, D. Fedorov, V.N. Fedosseev, L. Forster, B.A. Marsh, R.E. Rossel, S. Rothe, *M. Veinhard*, Nucl. Instr. Meth. A (2015), doi:10.1016/j.nima.2015.10.066

'Hot-cavity studies for the Resonance Ionization Laser Ion Source', *J.L. Henares*, N. Lecesne, *L. Hijazi*, B. Bastin, T. Kron, J. Lassen, F. Le Blanc, R. Leroy, B. Osmond, S. Raeder, F. Schneider, K. Wendt, Nucl. Instr. Meth. A (2015), doi:10.1016/j.nima.2015.10.061

'Experimental results of the laserwire emittance scanner for LINAC4 at CERN', *Thomas Hofmann*, Gary E. Boorman, Alessio Bosco, Enrico Bravin, Stephen M. Gibson, Konstantin O. Kruchinin, Uli Raich, Federico Roncarolo, Francesca Zocca, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2016.02.018

'Electron beam final focus system for Thomson scattering at ELBE', *J.M. Krämer*, M. Budde, F. Bødker, A. Irman, A. Jochmann, J.P. Kristensen, U. Lehnert, P. Michel, U. Schramm, Nucl. Instr. Meth. A (2015), doi:10.1016/j.nima.2015.10.067

'Coulomb field strength measurement by electro-optic spectral decoding system at the CALIFES beam line', *R. Pan*, S.P. Jamison, T. Lefevre, W.A. Gillespie, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2016.03.043

'Simulations of radiation pressure ion acceleration with the VEGA Petawatt laser', *Luca C. Stockhausen*, Ricardo Torres, Enrique Conejero Jarque, Nucl. Instr. Meth. A (2015), doi:10.1016/j.nima.2015.10.068

'Demonstration of a laserwire emittance scanner for hydrogen ion beams at CERN', *T. Hofmann*, K. O. Kruchinin, A. Bosco, S. M. Gibson, F. Roncarolo, G. Boorman, U. Raich, E. Bravin, J. K. Pozimski, A. Letchford, C. Gabor, Phys. Rev. ST Accel. Beams 18, 122801 (2015) (18.122801)

'Ion acceleration and plasma jet formation in ultra-thin foils undergoing expansion and relativistic transparency', M. King, R.J. Gray, H.W. Powell, D.A. MacLellan, B. Gonzalez-Izquierdo, *L.C. Stockhausen*, G.S. Hicks, N.P. Dover, D.R. Rusby, D.C. Carroll, H. Padda, R. Torres, S. Kar, R.J. Clarke, I.O. Musgrave, Z. Najmudin, M. Borghesi, D. Neely, P. McKenna, Nucl. Instr. Meth. A (2016), doi:10.1016/j.nima.2016.02.032

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Events

May 8th – 13th 2016	IPAC 16, Busan, South Korea
June 6th – 8th 2016	Photocathodes for Particle Accelerator Applications , Daresbury , UK
June 27th 2016	Researcher Careers Workshop, Krakow, Poland
June 29th – July 1st 2016	Workshop on a European Plasma Accelerator
August 28th – Sept 1st 2016	ECR Ion Sources workshop, Busan, South Korea
Sept 11th – 15th 2016	IBIC 16, Barcelona, Spain
Sept 25th – 30th 2016	LINAC 16, East Lansing, MI, USA
Oct 24th – 25th 2016	LA³NET Laser Ion Source Workshop, Paris, France
Oct 24th – 26th 2016	LA³NET Novel Accelerators Workshop, Paris, France
Oct 25th – 28th 2016	PCaPAC 2016, Campinas, Brazil

CORRECTING NOTE

Our previous newsletter included an incorrect acknowledgment of the authorship of an article presented. The correct acknowledgment is as follows:

'Proton acceleration enhanced by a plasma jet in expanding foils undergoing relativistic transparency', HH W Powell , M King, R J Gray, D A MacLellan, B Gonzalez-Izquierdo, L C Stockhausen, G Hicks, N P Dover, D R Rusby, D C Carroll, H Padda, R Torres, S Kar, R J Clarke, I O Musgrave, Z Najmudin, M Borghesi, D Neely and P McKenna, New J. Phys. 17 (2015) 103033 (10.1088).

We would like to thank Prof. McKenna and his group for their understanding of this unintentional error and their liaison with us to promptly correct this information.

DEADLINE FOR CONTRIBUTIONS TO THE NEXT NEWSLETTER: end May 2016

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.

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