

Special Interest Articles

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- Proton Beam Therapy offers exciting Career Opportunities
- oPAC and FCC: Shaping the Future of Particle Accelerators

Individual Highlights

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Accelerators have changed the World

Particle accelerators have found numerous applications in fundamental science and applied research applications. They are used as 'atom smashers' at international laboratories, generate shorted light pulses for cross-discipline research at Stanford's LCLS or the future XFEL, have enormous benefits for medical applications, and many advanced industrial processes and products would not be available without these machines. [Dr. Graeme Burt](#) from Lancaster University has summarized some of the applications in an [article](#) that has just appeared in *The Conversation*. The oPAC project has contributed significantly to a further optimization of existing and future accelerators and light sources and the results from our Fellows research projects are expected to benefit many facilities around the world.

Ways to further enhance particle beam therapy has been studied by several opAC Fellows in the past. I have recently written about the many benefits of such advanced treatment schemes in an [article](#) that was published in *Education Technology*. I am thrilled that the brand-new [OMA](#) network can offer 15 Fellowships to early career researchers that will all work in this R&D area. OMA currently invites [applications](#) for its Fellowships and I would appreciate if you could help spread the work about these exciting opportunities.

The commercialization of research results has gained considerable attention in recent years. In the UK, the Research Excellence Framework (REF), has pushed for clear(er) links between research and their (measurable) benefits for society at large.

Within oPAC we have promoted entrepreneurship, created awareness of IP rights and the patenting process through dedicated training to our own Fellows, as well as early career researchers from other networks and partnering universities. A Fellow from the network [LA³NET](#), Ms Alexandra Alexandrova from the Cockcroft Institute/University of Liverpool, has recently taken this approach to a new level by establishing her own company [D-BEAM](#). She builds up directly on her research experiences gained within an international network and is currently identifying the full market potential of beam diagnostics and detector applications for science and industry. I believe that this is fantastic development and result of the training vision our consortium has established a few years ago and wish her every success !

oPAC has decided to organize a Topical Workshop in Beam Loss Monitors in Barcelona on 15 and 16 September 2016, right after the International Beam Instrumentation Conference ([IBIC](#)). The program and speakers are currently being finalized and more information will soon be available via our [web page](#), [Facebook](#) and [Twitter](#) accounts. I hope that many of you will be able to join us on this occasion.

Many more news are included in this newsletter edition. Enjoy.



Carsten P. Welsch, Coordinator

Research News

Emilia Cruz Alaniz – Designing the Future of the LHC

The Large Hadron Collider has been providing proton-proton, lead-lead and proton-lead collisions since it started operations in 2009. Thanks to the data collected by the experiments several contributions have been made to particle physics. Most importantly, a Higgs-like boson was discovered in 2012, reaching a milestone in the understanding of nature.

Several upgrade options are currently being planned to build on the success of this machine. Amongst them, the High Luminosity LHC (HL-LHC) project aims to increase the luminosity of the LHC by a factor of ten. Another upgrade of the LHC is the large hadron electron collider (LHeC) aiming to make use of the LHC infrastructure to take electron-proton collisions into the Tera-electron Volts energy range. Particle physics in the past has profited from having different types of collisions and the LHeC aims to run synchronously with the HL-LHC. It would substantially extend and complete the physics research at highest energies.

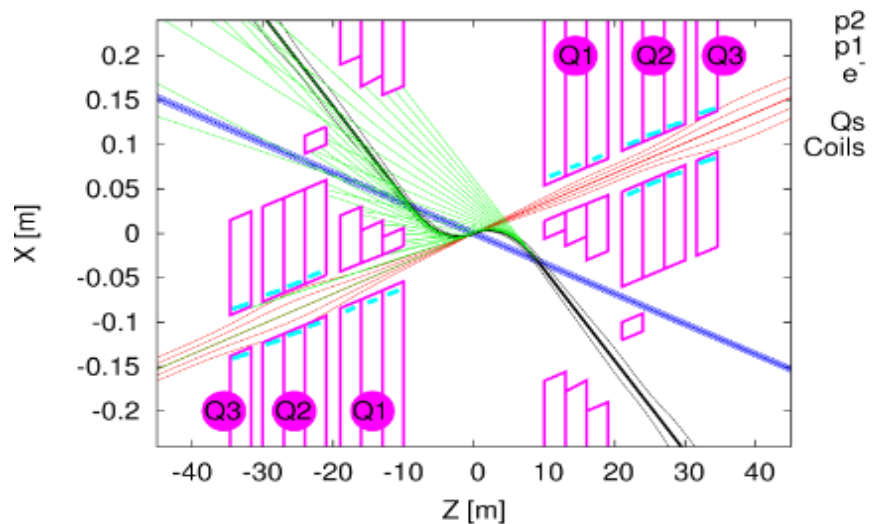
One of the key challenges in such energy frontier colliders is the design and optimization of the interaction region given that the beams are brought into crossing with the smallest beam sizes in a region where there are tight detector constraints. Integrating the LHeC into the existing HL-LHC design increases the overall difficulty of the task.

In a paper just published by oPAC Fellow **Emilia Cruz Alaniz** from the University of Liverpool in Physical Review STAB different design options for the LHeC interaction region are being considered. Emilia compares competing criteria that help identify an optimum balance between achieving ambitious luminosity goals whilst safely controlling the impact from collisions on the machine. The paper also presents ways to control beam stability and minimize the emitted synchrotron radiation power.

The full article can be accessed at: <http://journals.aps.org/prstab/abstract/10.1103/PhysRevSTAB.18.111001>



Emilia Cruz Alaniz



Focused proton beam 2 (red) colliding with electron beam (black) while unfocused proton beam 1 bypasses the interaction. Each proton and electron beam passes through its corresponding aperture in the inner triplet.

Konstantin Kruchinin and colleagues uses a “Lightsaber” to diagnose Particle Beams

In time for the global launch of the latest Star Wars movie “The Force Awakens”, oPAC Fellow Konstantin Kruchinin (Royal Holloway University of London) and LA³NET Fellow Thomas Hoffmann (CERN) 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*.

Similar to a lightsaber in the iconic movie series, their 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.” The paper is available in the journal’s website:

<http://journals.aps.org/prab/abstract/10.1103/PhysRevSTAB.18.122801>

Prof. Carsten Welsch added: “It is a pleasure to see these excellent results as a results from a 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.” These promising results will now form the basis for follow-on R&D projects.



Laser wire scanner experiment setup.

Network News

oPAC has finished, long live oPAC!

Monday 30th of November 2015 marked the official end to the oPAC project. This has been no ordinary project, being the largest European Training Network ever funded, it has managed to train 23 fellows in the optimization of particle accelerators and it has gathered a total of 35 partner institutions, between universities, research institutions and private companies.

Back in 2012 most of our trainees were just newcomers in the field of accelerator science. Now, after three years of hard work, they have acquired an interdisciplinary set of knowledge and skills that allows them to carry out cutting edge research. The training received has made them highly sought after by leading accelerator facilities and companies around the world.

It has been an intense but exciting journey. In addition to a large number of events where oPAC was present, we have organized five topical workshops, four training schools, an international conference, and an outreach symposium. The cherry on top was the International Conference on Accelerator Optimization in Seville, Spain, where our

fellows had the opportunity to shine showing the high quality of their research. The works will soon be presented as part of a Special Edition of Physical Review Special Topics: Accelerators and Beams.

It was also fantastic to see the manifold links that have been established between the fellows, the partner institutions and collaborating scientists since the project started in 2011. But has oPAC really come to an end? Thankfully not! The Steering Committee in its last meeting decided to continue supporting our fellows in their development and communicate their research results internationally, raise awareness of the need for further national and international training programmes in this exciting field, and also organize further events across the project's scientific work packages.

The coordination team is very happy and proud of having had the privilege to work with such a fantastic group of fellows and partners and wants to thank all the participants for their support and the always nice collaboration!



WHO ARE WE? oPAC!!!

Proton Beam Therapy offers exciting Career Opportunities



Image copyright Thomas Kästenbauer / MedAustron



The University of Liverpool together with a consortium of European institutions has put out a call for Fellows to join the network 'Optimisation of Medical Accelerators' (OMA) which starts in 2016. The new Marie Curie Initial Training Network (ITN) builds on the success of the oPAC project to train 15 Fellows in the design and optimisation of particle beam therapy facilities.

Prof. Carsten Welsch is the coordinator of the OMA initiative. He says: "The field of particle-beam therapy is still very much in evolution. Although we know that the potential of current proton beam therapy is not fully exploited the results have already been impressive, with patients experiencing extended periods of remission."

The major benefit of protons over X-rays is the control of the dose. X-ray dose deposition follows on exponential decay which means that treating a deep-seated tumour involves significant entrance and exit doses to healthy tissue around the tumour. In contrast, the proton beam travels through the healthy tissue before depositing most of its energy in a well-defined volume known as the Bragg peak. The beam can also be extremely well controlled to follow the outline of the tumour.

"A growing body of clinical evidence shows that there is great potential for proton and ion treatment, particularly for treatment of

cancers in children and where tumours are close to vital organs. The goal now is to maximise the therapeutic efficiency while reducing as much as possible the damage to surrounding tissues" says Prof. Welsch.

The big challenge is to reduce the size and the cost of these accelerators while improving their performance. This will require expanding horizons beyond the current technologies. New types of accelerating structures and beam delivery systems, advanced simulation tools and beyond state-of-the-art beam diagnostics for monitoring all important beam parameters are among the approaches being explored in the OMA initiative.

As in oPAC, research Fellows within OMA will have the opportunity to work at the forefront of science whilst gaining experience on complementary skills such as project management and communication. Workshops and conferences help to develop their links and collaborations, building a sense of community.

The network is currently looking for candidates for its 15 vacant Fellowship positions at institutions across Europe. The deadline for applications is 28th February 2016 and the programme will begin in October 2016. For more information please visit the website: www.oma-project.eu

oPAC and FCC: Shaping the Future of Particle Accelerators



The world is gearing up for the biggest physics experiment ever and oPAC is playing a crucial role in it. An international collaboration of 63 institutions from 24 countries has already started to design the potential successor of the LHC: the Future Circular Collider (FCC).

The LHC is currently the largest scientific facility ever built. With a circumference of 27 km, it used particle beams colliding at 7 – 8 TeV to discover the Higgs boson, one of the biggest scientific achievements of our generation.

The FCC has been proposed as a 100 km tunnel to collide protons at energies of over 100 TeV. With this increased energy scientists hope to shed light on some of the greatest mysteries of modern science like the nature of 'dark matter' or the imbalance between matter and antimatter in the Universe.

The LHC took over 25 years to conceive and build, that is why planning for its successor must start now. The FCC new accelerator poses a huge technological challenge that can only be addressed in a coordinated international effort involving the best of both research and industry.

oPAC fellows have been hard at work pushing the limits of technology beyond the current state-of-the-art to meet the demands of the next generation of accelerators. For example,

radiation monitors able to operate in cryogenic environments down to 2 Kelvin have been developed for the first time by **Marcin Bartosik** (CERN) in collaboration with oPAC partner CIVIDEC. **Konstantin Kruchinin** (Royal Holloway University of London) in turn has been investigating novel non-invasive methods for measuring the transversal profile of the particle beam without destroying it, a key requirement in modern accelerators. **Héctor García Morales** (Royal Holloway University of London) has designed and tested novel collimation techniques for the LHC, in order to optimise the signal to noise ratio in future experiments. On the other hand **Emilia Cruz Alaniz** (University of Liverpool) has specialised in simulations of the beam dynamics, minimising the size of the beam at the interaction region in order to increase the probability of the collisions in the upgrades to the LHC.

The FCC study is supported by the European Union through the European Circular Energy-Frontier Collider – [EuroCirCol](#) project. The project has received 3 M€ of funding within the Horizon 2020 program to produce a conceptual design study for a 100 TeV circular hadron collider by 2019. EuroCirCol is coordinated by CERN and brings together an international consortium of 16 beneficiary organisations, including oPAC partners ALBA and the University of Liverpool.



The FCC has been proposed as a 100 km tunnel to collide hadrons, leptons, or hadron – leptons at unprecedented energies.

oPAC Events

Stay tuned

The official end of the oPAC project does not mean the end of its activities by any means!

We are planning a Fellow Reunion event jointly with LA³NET fellows early this summer (venue and dates to be confirmed soon), and a Topical Workshop on Beam Loss Monitors in

Barcelona, 15 – 16 September, right after the International Beam Instrumentation Conference (IBIC), more details will follow soon. Stay tuned!

Upcoming Events

Future Circular Collider Meeting in Rome

The **second Annual Meeting** of the **Future Circular Collider study will take place from 11 to 15 April 2016 in Rome**. The meeting brings together the world's leading scientists and engineers and relevant industry representatives to set the goals for the coming year and further develop this globally coordinated strategy of converging activities. The preliminary agenda of the FCC Week 2016 is available at:

http://fccw2016.web.cern.ch/fccw2016/FCCWeek2016Agenda_v2.pdf

An overview of the progress in all study domains and the consolidated baselines will be given during the plenary sessions. During parallel sessions, specific areas of the study and report key findings will be reported. Selected topics will be considered for publication in a special edition of the peer-reviewed journal [Physical Review – Accelerators & Beams](#). There will also be an open poster session providing a platform to showcase new concepts and technologies with significant impact on the FCC-study. Three posters will be awarded for their: (1) transformative potential for the category of innovation (2) potential impact on industry and society (3) relevance for the technical feasibility study.

The FCC Week in Rome aspires to cover the different aspects covered by the FCC-study,

present the latest results of ongoing research, to exchange scientific views, to forge new collaborations and, most importantly, to create perspectives for young scientists. It will also feature contributions about the first results from the H2020 Design Study [EuroCirCol](#) that covers a number of research areas that have previously been studied within oPAC.

Registration is now open and can be done via the workshop website:

<http://fccw2016.web.cern.ch/fccw2016/>



oPAC Gangnam Style

oPAC will be present once again in the International Particle Accelerator Conference (IPAC) which takes place this year in Busan (South Korea), from 9 to 12 May.

oPAC project manager **Ricardo Torres** and fellow manager **Magdalena Klimontowska**

will travel all the way to the land of the infamous [Gangnam Style song](#) to promote the work of our fellows at the industrial exhibition.

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



Fellows News

oPAC Fellows leave the Nest

Their projects may have finished but the oPAC fellows haven't been idle.

Xiangcheng Chen has been the first fellow to obtain a PhD as a result of his work in oPAC. The thesis, entitled "Non-interceptive position detection for short-lived radioactive nuclei in heavy-ion storage rings" was successfully defended in November at Heidelberg University and was praised by the examiners for its excellent quality. The now Dr. Chen has subsequently got a postdoc position in the Institute of Modern Physics, Chinese Academy of Sciences in Lanzhou, where he continues his research on heavy ion storage rings in close collaboration with GSI and RIKEN.

Xiangcheng's academic achievements will hopefully be soon emulated by **Emilia Cruz Alaniz**. She has just submitted her PhD thesis and expects to defend it at the University of Liverpool in March. Not wanting to wait a minute to leave the nest she has flown to

Oxford where she is now working at the John Adams Institute for the EuroCircCol project, designing the interaction regions of the Future Circular Collider.

Pavel Maslov has started working at the Faculty of Computer Science and Informatics of the University of Ljubljana at the Laboratory for Integration of Information Systems, where he is in charge of two H2020 projects – AgrolIT and Flexiciency.

Finally **Blaine Lomberg** went back to his native South Africa where he is working as a Junior Lecturer at the University of the Western Cape. He is also collaborating with the National Accelerator Laboratory called iThemba LABS working on the development of a new Radioactive Ion Beam (RIB) Facility in South Africa.

To all of them, congratulations and the best of lucks in your new endeavours!



Dr. Chen

Interview with Héctor García Morales

Héctor García Morales was born in Barcelona, Spain, in 1987. He studied physics at the University of Barcelona and after completing his degree, he started his master studies in particle accelerators at the same university. His master thesis was carried out in collaboration with CERN and focused on the optics design of an emittance measurement station at the RTML line for CLIC. After presenting his master's thesis, he participated in the Joint Universities Accelerator School before getting a position at CERN as a PhD student.

In recent years Héctor has been focused on the study and optimization of the final focus system for future linear and circular colliders, especially on CLIC and ILC. During his PhD, he attended the Linear Collider School 2011 in Monterey, California. In 2014 Héctor joined the oPAC network at Royal Holloway University of London, where he continued his work in the LHC collimation systems.



Dr. García Morales



What did attract you to the oPAC network? Has it fulfilled your expectations?

The oPAC network is within the Marie Curie Research program which is very prestigious and this makes it attractive. Being part of an accelerator network also offers you the possibility to learn about other topics you are not directly working on. The amount and variety of activities carried out is probably one of the points that make the difference.

Why did you choose to go to Royal Holloway?

I love London and I love it even more after oPAC. I already knew part of the crew of Royal Holloway and that made the decision easier. But the key point was that the research crew is quite young and active.

Can you explain in a few words what your project was about and what have you achieved?

My project was about the optimization of the collimation system of the LHC towards its upgrade in 2025 HL-LHC. The collimation system removes particles with amplitude or energy deviations that become dangerous for the superconducting magnets that eventually might quench. In the future upgrade, the beam will carry almost twice the energy of the nominal LHC and the collimation system must be reoptimized.

What has oPAC provided you professionally?

First of all I learned a lot about how circular accelerators work since previously I was focused on linear colliders. But besides that, I think I got very useful research skills not directly related to my research thanks to the training sessions provided by the oPAC network.

What are your professional plans now that oPAC has finished?

I got a new contract at Royal Holloway to keep working on the LHC collimation group at CERN. My plan is to stay in research for a few years at least and after that, nobody knows.

What will be your most cherished memory from oPAC?

There are so many that it is difficult to just take one of them. Eating ham in the narrow streets of Seville, jumping over the trees in Liverpool, dancing in a dark and smoky tavern in Darmstadt, the "who are we?" oPAC haka, Ricardo's British jokes... But probably the nicest is to have met a lot of different people from around the globe.

And the one you'd rather forget?

There are no bad moments to forget. Probably I would like to forget as soon as possible this interview ;-)

Michele Carlà – Sparking the Love for Accelerator Science



Michele Carlà demonstrating his home-made Van de Graaff generator.

If you have to spark interest among teenagers about something they have never heard before, and as far from their everyday experience as particle accelerators, why not start with real sparks –massive, hair-rising, ear-cracking electric sparks?

That's the idea that former oPAC fellow **Michele Carlà** had when he was invited last November to the high school 'Institut Pla de les Moreres' in Vilanova del Camí, near Barcelona (Spain) to talk about the work he does in the synchrotron ALBA. He designed and built his own Van der Graaff generator to entertain the students with some nice sparks and introduce in the meantime the fundamentals of particle accelerators.

Everyone who studied physics has seen at least a sketch of a Van de Graaff generator in a book, but if you really want to build a working one from scratch you have to face some problems (especially if you want it to look nice).

Here is Michele's advice:

- 1) Design phase: Try to dimension the various components like belt length, width and speed.
- 2) Find the materials: The insulating column is a plastic pipe like the one used for rain gutter, the belt is a rubber band for exercise (neoprene is pretty good), the top collector is from an old pressure pot, the electric motor comes from a fan... etc. etc.
- 3) Solve some mechanical problems: I have never studied mechanical engineering or metal machining so this was something quite new to me. These gave me finally a good excuse to learn how to use a lathe and a milling machine, it was a nice experience. "The first attempt was kind of a failure, but after some improvement I was able to produce some beefy spark!" says Michele. We can be sure that the students were at least *electrified* by the demonstration. No casualties were reported.

Partner News

Instrumentation Technologies offers free Trials of Libera Products



Instrumentation Technologies knows how important it is to try the instrument's performance on-site before you buy it. Because they want you to be completely satisfied with your purchase, they offer you one month Libera tryout option.

You can test the following Libera instruments for free, except for shipping and duty charges:

[Libera Spark ER / ERXR](#): compact BPM electronics typically used in electron storage rings (ERXR) and booster rings (ER);

[Libera Spark EL/HL](#): compact BPM electronics typically used in electron (EL) and hadron (HL) linear accelerators and transfer lines;

[Libera Spark HR](#): compact BPM electronics

typically used in hadron circular machines;
[Libera BLM](#): beam loss monitor electronics with one X-ray PMT sensor;
[Libera Photon](#): photon beam position processor;

Libera Digit: general purpose 4-channel digitizer (AC coupled or DC coupled).

You will receive the Libera instrument completely customized to your machine (RF and revolution frequency). Instrumentation Technologies will also provide you all the technical support needed.

Please contact Instrumentation Technologies for more information support@i-tech.si.



Libera Workshop 2016

OPAC Partner Instrumentation Technologies has announced the [12th Libera Workshop](#), which will be held from 8th to 10th June 2016.

The workshop itself will be a one-day event held on 9th June. It will be preceded by training sessions and Libera instrument demonstrations on 8th June (optional attendance). Satellite meetings are planned for 10 June, upon prior arrangement.

The Libera Workshop is an opportunity to network with experts from the accelerator field and to explore how to optimise beam stability from injection to the end-station.

Participants will learn about the use of Libera instruments at different accelerators around the world, and obtain practical experience as well as intensive training. The workshop will focus on applications that use the Libera family of instruments – state-of-the-art instrumentation systems used for diagnostics and beam stabilisation at particle accelerators.

For more information on Libera Workshop 2016, please contact Instrumentation Technologies at sales@i-tech.si





The Cockcroft Institute opens its Doors to new Talents

The National Particle Accelerator Open Day 2015 took place recently at the Cockcroft Institute. It was aimed at undergraduate and postgraduate students looking for employment or studentships in the fields of accelerator science and technology.

An exciting program of events including talks and lab tours was provided to the students. They also had the chance to speak to current PhD students, Postdocs and academics from

the CI partner universities, as well as national laboratory and industry staff.

The oPAC, LA³NET, and brand-new OMA projects were represented to promote research, employment and training opportunities offered within ITNs. Hopefully the experience and success stories of oPAC and LA³NET will prompt current students to pursue a career in accelerator science.



National Particle Accelerator Open Day at the Cockcroft Institute, UK

Capitalising on oPAC Skills Training

Building on the experience of the oPAC complementary skills training program a similar training was provided last week to the first-year postgraduate students from the University of Liverpool's School of Physical Sciences.

During the four days' workshop **Prof. Carsten Welsch** (oPAC Coordinator) and **Magda Klimontowska** (LA³NET Project Manager) together with **Dr. Dave Joss** and **Dr. Shirley Cooper** 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.



Vacancies

[Marie Curie Early Stage Career Fellowship – OMA project](#)

Several locations around Europe

[Postdoctoral Research Associate \(PDRA\) position to work on the machine-detector interface of the Future Circular Collider](#)

The Cockcroft Institute / University of Manchester

[PhD Opportunities in the QUASAR Group](#)

Cockcroft Institute / University of Liverpool

Selected Publications

E. Cruz-Alaniz, D. Newton, R. Tomás, and M. Korostelev, “[Design of the large hadron electron collider interaction region](#)” Phys. Rev. ST Accel. Beams 18, 111001 (2015)

T. Hofmann, K. O. Kruchinin, A. Bosco, S. M. Gibson, F. Roncarolo, G. Boorman, U. Raich, E. Bravin, J. K. Pozimski, A. Letchford, and C. Gabor, “[Demonstration of a laserwire emittance scanner for hydrogen ion beams at CERN](#)”, Phys. Rev. ST Accel. Beams 18, 122801 (2015)

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Events

May 8 th – 19 th 2016	IPAC 16, Busan, Korea
June 8 th – 10 th 2016	12 th Libera Workshop, Solkan, Slovenia
June 13 th – 18 th 2016	12 th International Conference on Electron Beam Technologies, Varna, Bulgaria
June 15 th – 28 th 2016	2016 CERN-JINR European School of High-Energy Physics, Skeikampen, Norway
TBC	Fellows Reunion
Sept 11 th – 15 th 2016	IBIC 16, Barcelona, Spain
Sept 15 th – 16 th 2016	oPAC Topical Workshop on BLM, Barcelona, Spain
Sept 25 th – 30 th 2016	LINAC 16, East Lansing, MI, USA
Oct 24 th – 26 th 2016	LA ³ NET Topical Workshop on Novel Accelerating Techniques, Paris, France
Oct 25 th – 28 th 2016	PCAPAC 2016, Campinas, Brazil

NOTICE BOARD

Please send your contributions to the oPAC Book of Memories to Dr. Nika Vodopivec: nika.vodopivec@i-tech.si

Contributions to the Special Issue of Phys. Rev. Accelerators and Beams for the International Conference on Accelerator Optimization are still welcome!

DEADLINE FOR CONTRIBUTIONS TO THE NEXT NEWSLETTER **15th April 2016.**

About oPAC

The optimization of the performance of any Particle ACcelerator (oPAC) is the goal of this new network within the FP7 Marie Curie Initial Training Network (ITN) scheme. oPAC aims at developing long term collaboration and links between the involved teams across sectors and disciplinary boundaries and to thus help defining improved research and training standards.

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 289485.



www.opac-project.eu

