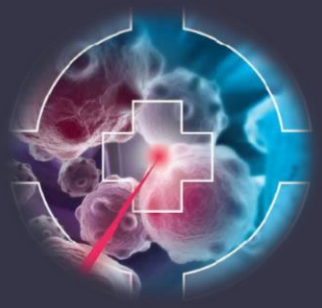


OMA Express
July 2019
Issue 10

Highlights

- Non-invasive measurement of beam intensity
- Advanced Researcher Career Skills School held in Liverpool
- Importance of medical applications showcased at international Symposium
- TRIUMF joins OMA

Discussing the state-of-the-art in particle therapy

More than 200 delegates joined our international Symposium on Accelerators for Science and Society in Liverpool on 28 June 2019. They gathered at the Arena and Convention Centre near the famous Albert Dock to follow talks about the use of particle accelerators for fundamental research, health and data, as well as the importance of creative subjects in combination with science and engineering to boost innovation. They also learned about several highly successful researcher training programmes, including OMA. The talks were followed by hands-on demonstrations developed by our Fellows for high school and college students, along posters about the research carried out within our network.

Since its start, the OMA project has built bridges between the accelerator science, beam instrumentation and medical communities. The network's three scientific work packages require a close collaboration across disciplinary boundaries in order to develop cutting-edge technologies and improve patient treatment.

The OMA research outcomes in the development of novel beam imaging and diagnostics systems, studies into treatment optimization including innovative schemes for beam delivery and enhanced biological and physical models in Monte Carlo codes, as well as R&D into facility design and optimization to ensure optimum patient treatment along with maximum efficiency will all be presented as part of an international conference on medical accelerators and particle therapy between 4-6 September 2019. The event will be hosted by the University of Seville/Centro Nacional de Aceleradores (CNA).

Confirmed keynote speakers include Katia Parodi (LMU), Yves Jongen (IBA), Guido Baroni (CNAO), and Tony Lomax (PSI). All participants will have the opportunity to present their own research in the form of a talk or poster. Selected proceedings will be published in a special edition of Physica Medica - European Journal of Medical Physics (EJMP). The registration fee includes accommodation, local transport, social events, and most meals. Abstract submission is now open and will close on **14 July 2019.** I hope to see you in Seville and wish you a very nice summer!

Prof. Carsten P. Welsch,
OMA Coordinator

Research News

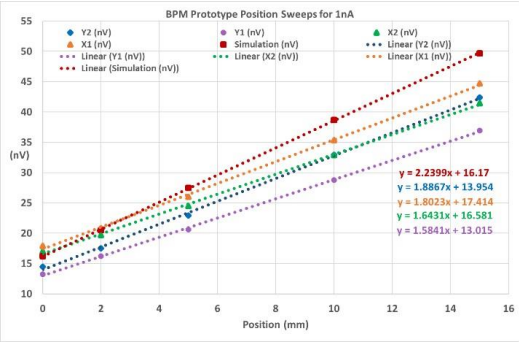
Non-invasive measurement of beam intensity

Low proton beam intensities (0.1-40 nA) are used for the treatment of tumours at the PROSCAN facility at the Paul Scherrer Institut (PSI). A cavity resonator using four quadrants operating in a dipole mode resonance has been developed to accurately measure beam position at such low intensities.

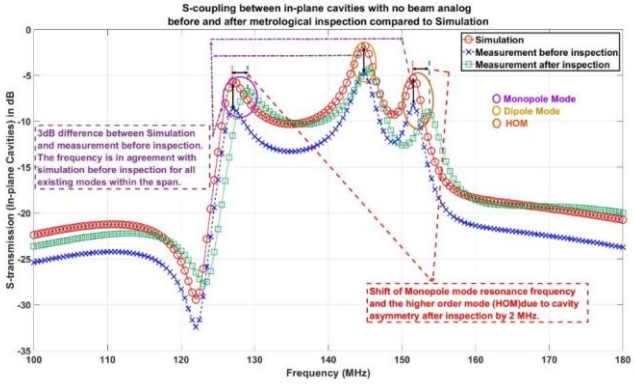
The TM110 resonance frequency of 145.7 MHz was matched to the second harmonic of the beam pulse repetition rate of 72.85 MHz. The code HFSS (High Frequency Structural Simulator) allowed optimizing the geometry of the beam position monitor and to analyze important parameters such as the pickup position, dielectric material choice and dimensions, etc.

A comparison between test bench measurements and simulation results gave overall good agreement. The measured position and signal sensitivity were found to be limited by the noise. It was possible to derive a position signal at beam intensities down to 10 nA .

In a paper presented at the world's largest particle accelerator conference, IPAC, OMA Fellow Sudharsan Srinivasan and co-authors discuss their findings and methods to increase the sensitivity. They show that a dipole cavity resonator is a very promising candidate for a non-invasive beam position diagnostic at medical facilities.



Position Sensitivity comparison between simulation and test bench for positive displacements.



S-transmission between in-plane cavities in the absence of beam analog before and after mechanical reassembly compared to Simulation.

Full details can be found in the IPAC proceedings:

S. Srinivasan, et al., **Quadrated Dielectric-Filled Reentrant Cavity Resonator as a Proton Beam Position Diagnostic**, Proc. IPAC, Melbourne, Australia (2019).

Network News

OMA at IPAC19

The world's largest conference on particle accelerators (IPAC'19) took place this year in the Australian city of Melbourne, from 19 to 24 of May. Over 1,000 delegates from five continents gathered in the Melbourne Exhibition Centre to hear about the latest advances in accelerator science through and intense programme of talks and poster sessions together with an industry exhibition.
There were several contributions from OMA Fellows to the scientific programme. This included posters by Ewa Oponowicz, Jacinta Yap, Navrit Bal and Sudharsan Srinivasan about with their latest research results.
Project Coordinator Prof Carsten Welsch presented a poster about research progress made in the network, as well as the various training events that have been held since project start.

A dedicated industry stand showcased the OMA project along with the many projects coordinated or participated by the University of Liverpool: AVA, LIV.DAT, EuPRAXIA and EuroCirCol, as well as the spin-out company D-Beam, specialized in advanced beam diagnostics.

The stand was also the platform to launch the 2nd issue of the OMA brochure which was distributed to conference participants from all over the world, showcasing Fellows' progress made and giving an overview of the many events and activities the network has already organized.
All contributions to IPAC can be found at http://www.ipac19.org.

University of Liverpool's industry stand at IPAC19.

Advanced Researcher Career Skills School held in Liverpool

Photograph of OMA and AVA Fellows with coordinator Professor Carsten P Welsch and Fistral trainers during the skills school.

The transition to the next job from a Marie Curie Fellowship is a challenging prospect in an ever more competitive job market. The European innovative training networks OMA and AVA, both coordinated by the University of Liverpool from the Cockcroft Institute, have held a joint 4-day Advanced Researcher Career Skills School on the main campus of the University of Liverpool for the networks' 30 Fellows between 24-27 June 2019.

The School provided dedicated support for a cohort of highly-skilled researchers to help them in their future career choices. External and internal trainers, including OMA partner Fistral, provided an extremely broad training throughout a week that targeted the next phase of the Fellows' careers. They provided advice on CV writing and interview skills, a session on how to write competitive grant applications, as well as information about best practice in science communication and networking. A day-long training about project management in collaborative research projects rounded off an intense week.

Professor Carsten Welsch who developed the training concept as part of the previous oPAC and LA3NET networks, said: *"Throughout the week, we focused on the specific skills that researchers need in order to be successful in their work – independent on whether they target a career in academia, industry or a clinical facility. The School gave many opportunities to discuss different career avenues, the challenges researchers find in different sectors, and to reflect on how the Fellows can be use the skills that they have now developed within the OMA project to boost their employability."*

This approach to researcher training has already been presented at a number of international learning and teaching conferences and will continue to serve as a model for future trainings. Special thanks go to the Liverpool staff members who contributed to the training and the Project TEAM for their help in the organization!

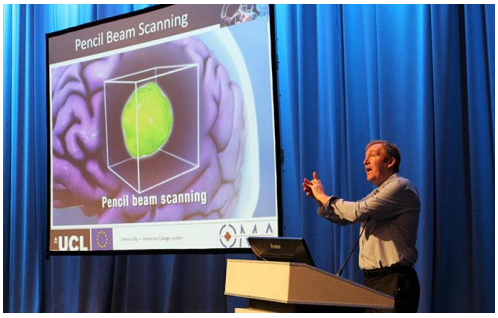
Importance of medical applications showcased at international Symposium

Particle accelerators have numerous applications across many fields including fundamental research, healthcare, electronics, environment and energy but, despite the significant role that accelerators play in our daily lives, the field of accelerator science and technology remains largely unknown to most people.

An international Symposium 'Accelerators for Science and Society' that took place at the Liverpool Arena and Convention Centre on Friday 28 June 2019, aimed to inspire students with the possibilities of this rapidly evolving field and provided insight into the economic, scientific and societal benefits of particle accelerators. The event was hailed a great success with delegates comprising of 100 researchers from across Europe and 150 students and teachers from local high schools.

Prof Welsch welcoming the delegates.

Renowned speakers such as Dr Michael Doser (CERN) and Prof Maria Fasli (University of Essex) provided a unique insight into how particle accelerators are used for antimatter research and how data plays a crucial role in accelerator-based experiments, as well as for society on a daily basis. Dr Simon Jolly (UCL) gave a talk about ion beam-based cancer therapy and explained the many challenges that are being addressed within the OMA project.



Dr Simon Jolly discussing ion beam-based cancer therapy.

In addition, international best-selling author and educator Curtis Jobling highlighted the importance of art and thinking creatively alongside studying STEM subjects and how this combination drives innovation across society.

Finally, Prof Carsten Welsch who leads the H2020 Marie Skłodowska-Curie training networks AVA and OMA, as well as the doctoral training centre LIVDAT on big data science which are behind the event, presented the very successful approach to researcher training that was stablished through the DITANET, oPAC and LA3NET projects and is now used for the three training programs that organized the event. All talks were live-streamed to institutions across Europe and are now available to watch via the event website.

Fellows presenting their research.

Early stage researchers from all three training initiatives presented their research in the form of posters and gave young delegates the opportunity to experience science up close through a number of interactive demonstrations that the scientists developed specifically for this event.

Interactive demonstrations.

Professor Welsch said: *"OMA has been training the next generation of medical accelerator experts since 2016 and will produce experts that go on to work around the world in academia, industry and at clinical facilities. It is fantastic to see the outstanding research results that have stemmed from our three most recent training initiatives and how our Fellows engaged with the next generation of scientists and engineers at the Symposium. The speakers provided an excellent overview of the many applications that particle accelerators have made possible in our everyday lives and in particular of how the use, handling and analysis of data impacts on science and society."*

More information and all talks can be accessed via the **event homepage**.

Upcoming OMA Event

International Conference on Medical Accelerators and Particle Therapy

Ion beam-based therapy is a leading research field in the treatment of cancer. Its optimisation requires advances in accelerator design, beam and patient diagnostics, as well as beyond state-of-the-art simulation tools.
The OMA consortium is organizing a 3-day International Conference on Medical Accelerators and Particle Therapy in Seville, Spain between 4th and 6th September 2019. The conference will be hosted by University of Seville/Centro Nacional de Aceleradores (CNA).
This meeting is an ideal place to present and discuss research advances in next-generation therapy accelerators, diagnostics for beam and patient monitoring, treatment planning, as well as medical facility and beam line design and optimisation. The event will feature talks from research leaders across the field of Medical Accelerator technology and also presents an opportunity for contributed talks and poster contributions.

The cost for participating is £600 including accommodation, full board and all social events. Several scholarships are available for early career researchers.

You will find more information and can register via the following link:

https://indico.cern.ch/event/803528/

Other Events

3rd AVA Topical Workshop: Machine-Experiment Interface

10th – 11th October 2019, COSYLAB, Ljubljana, Slovenia

A two-day workshop on 'Machine-Experiment Interface' with a focus on efficient diagnostics integration in an accelerator and how the readout from monitors can be linked to lattice design codes via online control systems will be organized by the AVA network. The event will be hosted by COSYLAB, Ljubljana, Slovenia on 10-11 October 2019 and will feature invited lectures, contributed talks and a half-day LabVIEW workshop.

Registration will open soon and more information will be provided via the AVA website.

LINAC2020 will take place in Liverpool

30th August – 4th September 2020, ACC Liverpool, UK

In 2020, the linear accelerator conference (LINAC) will come to England, the birthplace of accelerator science, and take place at the Arena and Convention Centre in beautiful Liverpool, UK on 30 August - 4 September 2020.

LINAC is the main bi-yearly gathering for the worldwide community of linear accelerator experts. The conference will provide a unique opportunity to hear about the latest advances in research and developments on hadron and lepton linacs and their applications.

Following a long and successful tradition, LINAC2020 will feature invited and contributed talks, as well as poster sessions and an industry exhibition. The scientific programme will be complemented by social events that promote informal knowledge exchange. There are a number of sponsorship opportunities for all those who would like to support the event and gain visibility.

LINAC encourages in particular students to participate and a number of scholarships will be offered. Registration will open later this summer and we encourage you to register early to secure a place.

More information is available via the conference website.

LINAC2020
LIVERPOOL

Fellows Activities

Anna Vnuchenko presented her latest research results at high gradient

Anna Vnuchenko presenting latest research results at HG2019.

Anna Vnuchenko participated in the 12th International Workshop on Breakdown Science and High-Gradient Technology, HG2019, hosted by CERN and held at Le Refuge des Aiglons in Chamonix, France from 10 to 14 June 2019. She presented the last high gradient test results that have been achieved from high power test of medical linac structure designed for protonotherapy and preliminary study of breakdown (BD) phenomena in Linac4 RFQ. This study is very important since BD is the main limiting parameters of high gradient performance of acceleration structures.

The workshop gathered the steadily widening range of communities who are developing and using high-gradient in accelerators as well as researchers studying the fundamental limits of high-fields and commercial partners, to share latest mysteries and results to promote the mutual development of this field. Fundamental theory, experiments, prototype testing, simulation, novel structures and fabrication through operational accelerators have been covered at HG workshops with presentations, a poster session and plenty of time for informal discussions.

Participation in such workshops is very important as it gives the opportunity to share experience and discuss general issues of achieving a high gradient in different acceleration structures for future linear colliders and other advanced accelerating applications.

Giulia Aricò talks at DKFZ careers day on Medical Physics

OMA Fellow Giulia Aricò was invited to participate in the Career Day on Medical Physics organized by the German Cancer Research Center (DKFZ) in Heidelberg, Germany. This event aims to provide a broad overview on possible career paths to young physicists and medical physicists, together with radiobiologists, clinician scientists, medical technicians, medical radiation technologists and radiotherapists.

Twelve speakers took part from all around the world, covering career possibilities within Academia, Clinics, as well as other sectors. Additionally, round-table discussions and one-on-one interviews with speakers and sponsors were organized. The participants were offered a board of job positions, as well as the possibility to add their CV to a "wall of fame".

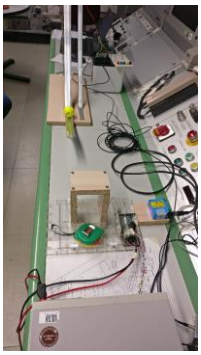
Giulia contributed by sharing her opinions and advices on "Research outside of Germany" with an audience of about 200 people, including Master and PhD students coming mainly from the University of Heidelberg and DKFZ, but also from other cities in Germany and from outside of Germany.

Giulia Aricò presenting at the DKFZ careers day.

Giulia found the participants to be very interested, curious and full of concerns, such as "how to find the right job?", "how to write a good CV?", "how to apply for a job position?". The most discussed topics were "how to highlight your skills, so to make yourself special and different from other candidates", as well as "how/when to move from Academia to Industry and vice versa", as well as "research outside the university sector".

This event was a fantastic opportunity for young researchers to look for professional offers, network, and picture themselves working in academia, clinics, consulting, publishing, business development and R&D.

WP3 OMA Fellows convene to create accelerator demo



Overview of setup.

The Accelerators for Science and Society Symposium took place on 28 June 2019 at the Arena and Convention Centre in Liverpool, and focused on connecting teenage students who are aspiring scientists to world class research in medical and accelerator physics. As part of this symposium, experts in these topics of research - the OMA Fellows - were in charge of introducing the topics of their work package through demonstrations and a poster presentation.
In preparation of the Symposium, the OMA Fellows belonging to work package 3 (WP3), (focused on *R&D solutions in patient treatment optimization*) designed an outreach activity in order to show the main advantages, as well as challenges, of particle therapy treatments. In particular, they focused on handling and mitigating patient motion and ion fragmentation.
In order to demonstrate the challenges in particle therapy, the Fellows decided to build a demo accelerator that highlights the precision of the dose deposition for any given energy, in the form of a ball which will only hit a target when released from a specific height (potential energy).

To represent the challenges of synchronization to tumor motion, the Fellows placed the target on a moving platform, making it necessary to coordinate the ball release with the table movement.
In May 2019, OMA Fellows Samuele Cotta, Charalampos Kalantzopoulos and Michelle Lis met at GSI in Darmstadt, Germany to create, test and finish the outreach demonstration. The great collaboration between them resulted in a very successful activity for the Symposium.

The outreach demonstration at the symposium.

Complementary to the interactive demo, the rest of the Fellows in this work package, Giulia Aricò and Liheng Tian, prepared several slides summarizing the basic concepts of hadron therapy and treatment planning. Furthermore, videos of moving targets in real clinical patients were prepared.

Explaining the basic concepts of hadron therapy.

Finally, the WP3 Fellows also prepared a poster which was used to illustrate and discuss the rationale for hadron therapy, main sources of uncertainties, tumor monitoring techniques and the role of Monte Carlo simulations.

Michelle Lis visits CNAO for experiments

Michelle Lis and the moving targets team from GSI Helmholtzzentrum fuer Schwerionenforschung recently performed first validation experiments and integration testing at the National Centre of Oncological Hadrontherapy (CNAO) in Pavia, Italy.
These experiments confirmed the functionality of the 4D robust optimized dose delivery method on a clinical treatment control system. The initial functionality experiments have already been performed at GSI in February, confirming the ability to accurately mitigate motion for one-energy plans. The system was then modified for compatibility at CNAO's peripheral hardware and timing system, including the interlock system.
The experiments performed at CNAO and at GSI involved delivering 2D geometries to a matrix detector and films, which were mounted on a sliding platform. The platform moved in a sinusoidal manner, to simulate simple respiratory motion, and the motion was measured with a laser distance sensor, and fed back into a motion monitoring system, which directs treatment delivery sequence and progression. The results of these experiments have shown that the 4D robust optimization strategy can provide clinically acceptable dose deliveries in simplified settings, and the final step in her study will be to adopt more realistic patient scenarios into the system.
The completion of Michelle's project will provide a clinically viable solution, targeted to treat lung and other thoracic tumor patients who generally have low 5-year survival rate. The dose delivery system will provide an accurate method for treating complex tumors while sparing surrounding organs from radiation damage.

OMA Fellows contribute to PTCOG

The Particle Therapy Co-Operative Group (PTCOG) conference took place in Manchester, UK between 10-15 June 2019. PTCOG brings together leading clinicians, physicists and other practitioners in particle therapy to share the latest clinical, scientific and industrial developments and showcase the latest technology which can help patients.

The North West of England's heritage as a pioneering region in cancer research and treatment for more than 100 years played a key part in bringing this important conference to the UK. This year also marks the 100th anniversary of Rutherford's 1919 breakthrough in understanding the structure of the atom and discovering the proton – and Manchester was the perfect place to celebrate this anniversary.

The conference, held at Manchester Central, coincided with the opening of the first NHS high energy proton beam therapy centre at The Christie in December 2018 and was thus extremely timely.

Several OMA Fellows contributed to the conference programme through poster contributions. This included a poster by Laurent Kelleter (UCL) on a *scintillator-based range telescope for quality assurance in particle therapy*, *end-to-end simulations of the Clatterbridge eye proton therapy beamline* by Jacinta Yap, as well as a contribution on *implementation and first tests of the CNAO dose delivery system at GSI* by M. Lis (GSI). A particular highlight was an oral contribution by our Fellow Liheng Tian (LMU) on a *new treatment planning concept accounting for in-vivo range verification in proton therapy*. PTCOG59 will take place 9-14 May 2020 in Taipai, Taiwan.

More information about the conference can be found on the event website:

https://ptcog58.org/

Partner News

New Adjunct Partner: TRIUMF joins OMA

The OMA consortium has been joined by a new adjunct partner: TRIUMF - Canada's particle accelerator centre.

TRIUMF was founded in 1968 by Simon Fraser University, the University of British Columbia, and the University of Victoria in order to meet research needs that no single university could provide. The original acronym, stemming from the name TRI University Meson Facility, was dropped and is no longer used to reflect TRIUMF's current state as a consortium of 20 member and associate universities from across Canada.

Since its foundation, TRIUMF has stood at the frontier of scientific understanding as Canada's leading particle and nuclear physics centre. TRIUMF houses the world's largest cyclotron, as well as a unique superconducting linear accelerator.

TRIUMF's Life Sciences division covers a range of research activities that are of high relevance to OMA, including:

- Isotope production R&D for targeted alpha therapy (TAT) with Ac-225;
- Additive manufacturing for beam shaping and organ shaped phantoms for proton therapy;
- organic and inorganic fibers for proton therapy dosimetry;
- prompt gamma measurement for dose verification in proton therapy;
- Use of gold nanoparticles as radiosensitizer for proton therapy;
- Development of a new photon FLASH facility.

TRIUMF nicely complements the expertise in OMA and offers exciting opportunities for collaborative research and secondments to our Fellows.

Welcome!

Vacancies

Engineer at Instrumentation Technologies
Instrumentation Technologies is looking for a talented and enthusiastic candidates to join their team of engineers. They are currently looking to hire six new engineers for the following positions: Support Engineer, Sales Engineer, SW Engineer, FPGA Engineer, Head of Quality Control and Business Developer.

Instrumentation Technologies is a leading global provider of beam diagnostic instrumentation for particle accelerators. These instruments, which are marketed under the Libera brand, present a benchmark in the field of advanced particle accelerators all over the world. Over the past two years, the company has also introduced development services for leading companies in the USA and the EU in the fields of IoT, MedTech and smart cities.

They offer an opportunity for fast career growth. You will develop skills used in fields such as Customer Support, Product Management and Team Work. You will also have an opportunity to travel the world and to become acquainted with different cultures. The company is located in Solkan, Slovenia (close to the Slovenian-Italian border).

If interested, please send your CV and cover letter to hrm@i-tech.si

Postdoctoral research associate in physics at University of Liverpool
The Department of Physics at the University of Liverpool is seeking a postdoctoral research associate in sensor and diagnostic technologies. You will work with industry partners to identify technical requirements and apply the sensor and detector technologies research and knowledge that have been developed across the nuclear, particle and accelerator clusters in the Department of Physics. By performing applied R&D, the post holder will develop innovative solutions for major challenges and problems facing industry. The ability to communicate effectively within a large multi-national collaboration is essential; **deadline for applications is 14 July 2019**.
Apply now!

Beam Instrumentation Engineer at MedAustron
EBG MedAustron GmbH in Wiener Neustadt operates one of the most modern centers for particle therapy and research in Europe. Cancer patients are treated with an innovative form of radiation therapy with protons and carbon ions. In addition to cancer treatment the facility is also used for translational research.

Our AVID team is responsible for all beam instrumentation and beam interception devices of the particle accelerator. The responsibility for accelerating structures, RF systems, ion sources and vacuum installations completes the team's profile.

Interested in becoming part of the AVID team as a Beam Instrumentation Engineer – find out more

Upcoming Events

August 26th – 30th 2019	FEL19, Hamburg Germany
September 4th – 6th 2019	International Conference on Optimization of Medical Accelerators, Seville, Spain
September 8th – 12th 2019	IBIC19, Malmö, Sweden
9th – 10th October 2019	3rd AVA Topical Workshop on Machine-Experiment Interface, Cosylab, Slovenia
March 2020	2nd AVA School on Precision Studies, Prague, Czech Republic
May 10th – 15th 2020	IPAC20, Caen, France
Aug 30th - Sept 4th 2020	LINAC2020, ACC Liverpool, UK

NOTICE BOARD

This newsletter is published on a quarterly basis. Help us keep it interesting by providing your news and updates

DEADLINE FOR THE NEXT NEWSLETTER **30th September 2019**

www.oma-project.eu

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