

Highlights

- Beamline measurements completed with PSI Cavity BPM
- OMA International Conference held in Seville
- Advancing knowledge in Radiobiological Effects of Protons
- MedAustron treats first patient using carbon-ion therapy

Where is ion beam therapy heading?

More than 70 delegates from all over the world joined our international conference on Medical Accelerators and Particle Therapy in sunny Seville.

The National Center for Accelerators (CNA) was, once again, a fantastic host for a major meeting and a huge thank you goes to Begoña, Anna and Miguel, as well as my project TEAM for their perfect support. Everything ran like clockwork.

Leading researchers presenting the latest R&D in invited talks really gave us an idea of where ion beam therapy will be heading next. It also created awareness of the many challenges that still have to be addressed to fully optimize this form of cancer treatment.

It was fantastic to see the research outcomes of our OMA Fellows and just how much they have achieved in only three years of R&D within our network. Most of them started their journey

with little background in particle therapy or accelerator science and now they were presenting cutting edge results to the world's experts in this field.

The first of our Fellows have now continued their journey as researchers outside of our network. Johannes and Samuele have already started their new jobs and in this OMA Express we start sharing their "next steps" with you. We will continue to do this for our other Fellows in future issues of our newsletter.

Many additional R&D projects have already emerged on the basis of the OMA project. I am sure that many will follow and benefit from the unique collaborative links that we have now established. I would like to encourage all OMA partners to actively seek joint R&D projects and continue to push this exciting field.

Prof Dr Carsten P Welsch
OMA Coordinator

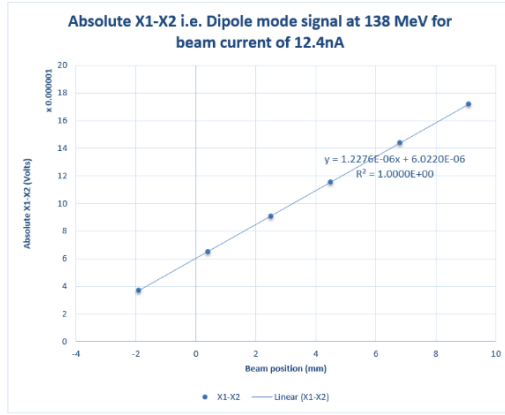
Research News

Beamline measurements completed with PSI Cavity BPM

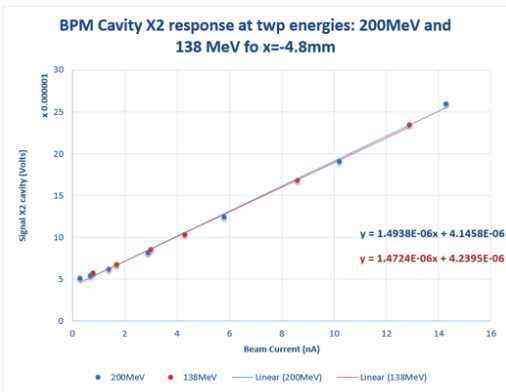
Sudharsan Srinivasan, OMA Fellow based at PSI in Switzerland, has successfully completed measurements with beam of a non-invasive beam position monitor (BPM).

This prototype is developed on the principle of using the electric dipole resonance mode, so-called TM110 mode. Earlier in the year, successful test-bench measurements were conducted and paved way for installation of the device in the beamline and measurements with beam. Prior to installation, cavity asymmetries were induced in the BPM prototype while reassembling. This shifted the dipole mode from the target frequency of 145.7 MHz by approximately 0.5 MHz for the horizontal plane and by 2.4 MHz for the vertical plane, thus affecting the signal sensitivity of the BPM.

The preliminary results shown above are taken from measurements in the horizontal plane where the resonance shift resonance is very small.



Absolute signal of the dipole mode at 138MeV. Subtracting the two X plane cavities subtracts the monopole mode and doubles the amplitude of the dipole mode. The absolute signal is directly proportional to the beam offset.



Signal sensitivity as a function of beam current for two different beam energies: 138 MeV and 200 MeV.

It was found that BPM behaves as expected and gives a signal that is proportional to beam intensity for a given offset. In addition, since the BPM signal is a function of the bunch charge and beam offset, it was demonstrated that the signal output was not significantly influenced by beam energy.

By subtracting two horizontal signals, the monopole mode can be eliminated, doubling the amplitude of the dipole mode signal which is proportional to the beam offset. This enhances the sensitivity of the measurement as can be seen in the plot below.

The measurements have successfully demonstrated the superior performance of this new monitor, making it a very interesting solution for essentially any medical accelerator.



Network News

International Conference on Medical Accelerators and Particle Therapy held in Seville



Participants at the OMA International Conference.

The Marie Curie Innovative Training Network OMA – Optimization of Medical Accelerators - has held its final official event in the form of an International Conference on Medical Accelerators and Particle Therapy. The conference took place from 4-6 September 2019 at the headquarters of one of the project partners, the Centro Nacional de Aceleradores (CNA) in Seville, (Spain).

This international event was an ideal place to present and discuss OMA research outcomes, including diagnostics for beam and patient monitoring, treatment planning, as well as medical facility and beam line design and optimization. The conference featured invited talks from research leaders, contributed talks and poster contributions. More than 70 delegates from all around the world participated in the event.

Following the very successful conferences held within the framework of the earlier [DITANET](#) and [oPAC](#) projects, Seville offered once again a perfect environment to discuss the latest research advances. The

event was started with a welcome address by Margarita Paneque Sosa, Institutional Delegate of CSIC in Andalusia, Patricia Aparicio Fernández, Director of the Secretariat of Research Centres, Institutes and Services of the University of Seville and Jose María López Gutiérrez, Deputy Director of the CNA.

OMA Coordinator Carsten Welsch then gave an overview of the network and wider context in which it is placed. He talked about the research challenges that the OMA Fellows are addressing across the three scientific work packages, as well as the unique approach to researcher training taken by the consortium.

Professor Welsch said: *“I am delighted that our conference attracted a number of high profile speakers, such as IBA founder Yves Jongen who presented a fascinating outlook on next-generation therapy accelerators and the opportunities different technologies can offer.”*

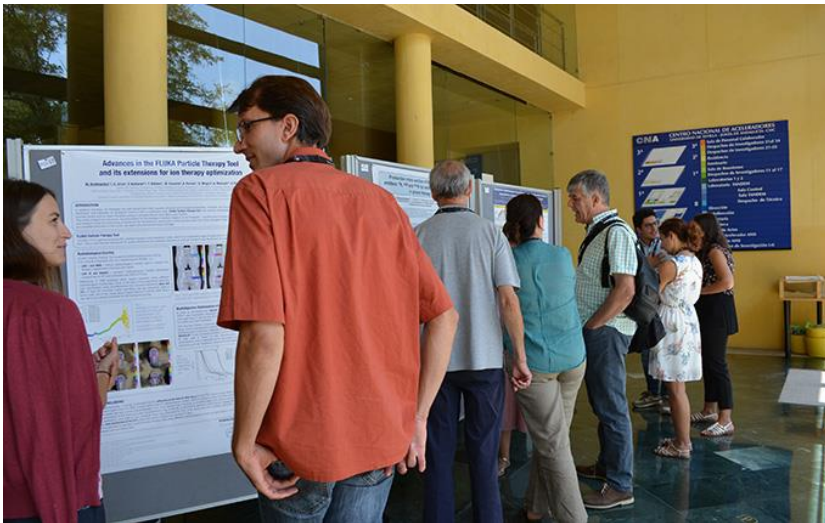
Other invited speakers included Katia Parodi/LMU (in-patient beam imaging), Michele Caldara/ADAM (beam diagnostics), Tony Lomax/PSI (Dose delivery), Antonio Lallena (Monte Carlo Dosimetry), Simon Marcelis (Dosimetry and QA) and Guido Baroni (4D patient monitoring). They were joined by the OMA Fellows who presented a summary of their research projects, and other delegates who contributed talks to the conference. This gave an interesting programme and included many hot topics, such as FLASH therapy. A poster session on the Thursday afternoon allowed further discussions between delegates. All participants were invited to contribute an article about their research to the conference proceedings, which will be published in the European Journal of Medical Physics.

In order to raise more awareness of the importance of accelerators for science and society the conference also sponsored an outreach talk, especially addressed to the Spanish public, about the treatment of cancer with particle accelerators. The talk, given by Professor María Isabel Gallardo, from the University of Seville, reviewed the history of

radiotherapy, the physical principles of their efficacy in diagnosing and treating cancer, and the future prospects of radiological techniques. Professor Gallardo highlighted the hope offered by accelerators of a definitive cure for cancer, if only the necessary investments were made in facilities for ion therapy. The talk was attended by a large group from the general public, as well as students, who showed their interest in the topic by actively engaging in many questions.

Professor Welsch added: *“OMA has been a fascinating journey for all of us. It makes me incredibly proud to see the excellent research results of our Fellows here at this conference. They have followed a unique training programme, which I am sure will provide them with an excellent basis for their future careers. Medical accelerators is an exciting area of research and our research helps save lives and improve cancer therapy.”*

More information about the event and all talks can be found on the [conference web page](#). The network is much obliged to CNA for hosting the conference and to all our Fellows who contributed to the success of the event.



Lively discussions during the afternoon poster session.

OMA Careers Workshop



Participants of the OMA Careers Workshop

The OMA network organized a Researcher Careers Workshop in the beautiful city of Seville, Spain on 2–3 September 2019. This event was held exclusively for the OMA Fellows and researchers from the National Accelerator Centre (CNA) in Seville.

As the OMA Fellows' training within the European network is coming to an end, they are looking for their next career move. Given the comprehensive nature of their interdisciplinary training, they are looking at opportunities across Europe and in many different sectors. To give them a better insight into the options that are now available to them, invited speakers presented career opportunities on the example of their own careers during this 2-day workshop.

Amongst the career pathways that speakers covered, were the academic sector, highlighting the various challenges that have to be met by any researcher wishing to pursue a university career; particle therapy; research into medical imaging and isotope production;

national and international research centers; SMEs in Spain and the EU; finance sector.

A talk about funding opportunities for early stage researchers completed the program. The workshop was organized by Drs Javier Resta-Lopez, Dr Narender Kumar and OMA Coordinator Professor Carsten Welsch with strong support by colleagues from CNA.

Dr Resta-Lopez said: *"We had two days of intense discussions about the challenges and opportunities for researchers on the international job market. The speakers gave us a very personal insight into their own careers and the difficult choices they had to make. This was eye-opening in many cases and shone light onto aspects of career planning that are not usually covered in this type of event."*

All workshop contributions can be found on the [event webpage](#).

Upcoming Events

AVA International School on Precision Studies

23rd – 27th March 2020, Prague, Czech Republic

The 'International School on Precision Studies' will take place in Prague, Czech Republic from 23-27 March 2020. Lectures and topical talks will be presented by world-leading physicists. They will present the latest results in theoretical and experimental antimatter studies along with wider research in accelerator science and particle physics.

All school participants will get the opportunity to present their own work in the form of posters. Social events, an excursion to ELI, and a public talk on antimatter research will complement the programme.

Several scholarships for early stage researchers from outside of the AVA network will be available.

Event homepage

<https://indico.cern.ch/event/854237/>

Registration deadline 31st December 2019

Abstract submission for poster presentation deadline 31st December 2019



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](#).



Fellows Activities

Sudharsan visits IBA



Image courtesy IBA.

OMA Fellow [Sudharsan Srinivasan](#), from the Paul Scherrer Institute (Switzerland) has recently spent three weeks on secondment in the facilities of [IBA](#) – Ion Beam Applications in Louvain-La-Neuve (Belgium). Since this was Sudharsan's second visit to IBA, it was easy for him to adapt to the Physics research group. Sudharsan spent his time working with the group on potential improvements to his beam diagnostics, and the benefits it could offer as compared to

ionization chambers. The discussions focused on specific design considerations for isochronous cyclotrons and synchrocyclotrons. This led to the design of cavity resonators that could be translated to IBA Proton Therapy systems as current monitors, but with similar dimensions to an ionization chamber.

Discussions were also held about their application to FLASH as it is expected that the signal integration time could be in the same regime as that of ionization chambers. The influence of energy spread on the resonator sensitivity was put forward for discussion and ideas about designing the cavities on the fundamental RF frequency was considered. Sudharsan could also explore its applicability for Time-Of-Flight measurements (for energy evaluation) and for dosimetry as a function of beam current and energy.

This secondment has been very beneficial for Sudharsan and has opened possibilities for further collaborations.

Spotlight on Johannes Petzoldt

What attracted you to the OMA network? Has it fulfilled your expectations?

"The OMA network is a unique training network in the field of proton therapy as it combines basic research in academia with applied research in industry and great training opportunities for all fellows and participants. Working already in the field of proton therapy on academia side, it was my strong desire to continue my research topics and try to apply them in the clinical scenario which was possible due to the offered positions in industry. The network has further brought me together with brilliant researchers from all over the world, so it has fulfilled all my expectations."

Why did you choose to go to IBA?

"I worked already for some time in the field of proton therapy, especially with the focus of range verification using prompt gamma techniques. After working in academia, I wanted to continue my research in a company which allows me to bring my ideas to the patient. The offered position at IBA was the perfect match – continuing my research on prompt gamma imaging and developing tools that help using an existing prototype for prompt gamma-based range verification during patient treatment."



Can you explain in simple terms what your project was about and what have you achieved?

"Proton therapy is a highly targeted method to destroy tumor cells. Sometimes though, there are uncertainties if the proton beam is actually stopping where it is supposed to stop. Therefore, researchers are working on methods to indirectly make the beam visible inside the patient. In my project, a specific type of camera tries to measure gamma radiation that is coming out of the patient during the treatment. By creating an image of this radiation, we know if the beam stopped at the exact position or not. This is what we call prompt gamma imaging or prompt gamma-based range verification. The system developed at IBA is so-far the only one that was used during patient treatment showing very promising results. My contribution was to make the prototype more user-friendly, more precise and more reliable. I developed software upgrade, a correction model to improve the accuracy and a mechanical positioning system that allows to use the prompt gamma camera more reliable and also during other types of treatments. With this mechanical system, we could improve the workflow and save valuable time during the patient treatment. I also supported other scientists with their studies using the prompt gamma camera prototype."

What has OMA provided you in terms of your professional development?

"OMA brought me together with other young researchers starting in the field of particle therapy (the other OMA fellows and further students joining for trainings and schools hosted and organized by OMA) and

experienced and highly professional scientists already working in the field for a long time. Also, OMA brought academy (universities and research institutes) together with industry. This allowed me to work with people who have totally different backgrounds and motivations and to push my own ideas and understand the requirements in my project. Also, the OMA project organized workshops, trainings, and schools in which I learned about soft-skills, science related topics, project management etc. It improved my overall skillset in many dimensions, and I see my strong professional and personal development after those 3 years of OMA."

Can you say something about your next career move?

"During the 3 years of OMA, I experienced a great team and working spirit at IBA and was happy to be given the opportunity to work with such a great team and to live in Belgium. All this experience offered the exciting opportunity to apply and be selected for a new position in Germany as R&D scientist for the world leading mass spectrometer manufacturer."

What will be your most cherished memory from OMA?

"It is hard to condense 3 years of OMA project in one "best" memory, but I definitely cannot stop smiling when I think about the cooking session together with Sud and some of the other fellows during the OMA school in Munich. We had some delicious Indian food prepared by Sud in our small hotel room kitchen, and of course a few "Helle" together with it."

[Find out more about Johannes Petzoldt](#)



Advancing Knowledge in Radiobiological Effects of Protons



OMA Fellows Jacinta Yap and Giulia Aricò at CERN.

In August, OMA Fellow [Jacinta Yap](#) spent two weeks on secondment at CERN. She was hosted by the FLUKA team and spent her time working alongside OMA Fellow [Giulia Aricò](#) in the EN-STI-FLUKA section, as well as her colleagues in the beam machine interactions section.

Jacinta described being amongst a different research atmosphere and interacting with many different people working on diverse projects as an energising experience. Home to the Large Hadron Collider, CERN is the largest particle physics laboratory in the world, bringing together and training people from all around the world to investigate the fundamental questions of our universe.

Jacinta was able to gain insight into the dynamics and operations of a large scale, international research organisation and how each individual and section contributes to wider objectives. Many different groups focus

on work across different fields of sciences, including many areas applicable to the OMA project. As Jacinta and Giulia both work on projects involving Monte Carlo simulations, the secondment provided an opportunity for many related discussions and collaborative avenues of work. In particular, they are investigating opportunities for linking beam transport simulation outcomes to treatment planning studies. This might enable more precise cancer treatment planning for a specific clinical facility

In addition to this work, Jacinta also had a chance to visit different LHC experiments and learn more about the massive detector systems and related physical concepts. The secondment was a thoroughly enjoyable and valuable experience for Jacinta and she looks forward to applying what she has learnt to her project and career.

OMA Fellow takes part in CERN Accelerator School

OMA Fellow [Sudharsan Srinivasan](#), has attended the [CERN Accelerator School](#) on “Basics of Accelerator Physics and Technology” at the European Scientific Institute ([ESI](#)) in Archamps (France) from 7 to 11 October 2019.

This introductory level course was targeted mainly to engineers and technical staff, therefore it was centered on the practical aspects of accelerator physics. Special emphasis was given on the CERN machines

and their applications, for instance the challenges of the Future Circular Collider and the High Luminosity upgrade of the LHC. The lectures covered a diverse range of topics, including beam dynamics, wakefield acceleration and cryogenics, to name a few.

Sudharsan used this opportunity to network with some of the brightest minds at the world’s largest particle accelerator facility hence opening the way to future collaborations and knowledge exchange.



ESI, Archamps, France (Image credit ESI)



Partner News

MedAustron treats first patient using carbon-ion therapy

OMA Partner [MedAustron](#) is one of the most advanced centres for ion beam therapy and research in Europe. Compared to conventional radiation therapy, this treatment is able to reduce radiation exposure to adjacent healthy tissue and spares the tissue behind the tumour almost entirely. Therefore, ion beam therapy is an optimal treatment for tumours close to radio-sensitive organs, like the brain and the spinal cord, eyes, liver and lungs.

After having started clinical operation with protons two and a half years ago, MedAustron has continuously increased the number of patients treated and expanded their range of indications.

A significant [milestone has now been reached](#) - whereas patients were previously treated exclusively with protons, carbon ion therapy is now also available. With carbon ion

irradiation, charged carbon nuclei are directed at the tumour. These are loaded with energy and heavier than protons and so provide an even higher biological effectiveness. This form of treatment opens up new opportunities for tumours that were previously difficult or impossible to treat.

Initially, treatment with carbon ions focuses primarily on tumours in the head and neck region and at the base of the skull. The spectrum will be continuously expanded, for example to include gastrointestinal indications such as pancreatic or rectal carcinomas and sarcomas.

Hereby, MedAustron is joining the ranks of only six centres worldwide that can combat tumours with both protons and carbon ions.

More information: [New era for cancer treatment by irradiation with carbon ions](#)



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Selected Publications

[Dose-averaged LET calculation for proton track segments using microdosimetric Monte Carlo simulations](#)

Bertolet, A.; Baratto-Roldan, A.; Barbieri, S.; Baiocco, G.; Carabe, A.; Cortes-Giraldo, M. A.
MEDICAL PHYSICS 46 (9), 4184 – 4192 (SEP 2019)

[Segment-averaged LET concept and analytical calculation from microdosimetric quantities in proton radiation therapy](#)

Bertolet, A.; Baratto-Roldan, A.; Cortes-Giraldo, M. A.; Carabe-Fernandez, A.
MEDICAL PHYSICS 46 (9), 4204 – 4214 (SEP 2019)

[Parameterising microdosimetric distributions of mono-energetic proton beams for fast estimates of \$y_D\$ and \$y^* S\$](#)

Perales, Alvaro; Baratto-Roldan, Anna; Kimstrand, Peter; Antonio Cortes-Giraldo, Miguel; Carabe, Alejandro
BIOMEDICAL PHYSICS & ENGINEERING EXPRESS 5 (4), UNSP 045014 (JUL 2019)

[Technical Note: Simulation of dose buildup in proton pencil beams](#)

Kelleter, Laurent; Tham, Benjamin Zhen-Hong; Saakyan, Ruben; Griffiths, Jennifer; Amos, Richard; Jolly, Simon; Gibson, Adam
MEDICAL PHYSICS 46 (8), 3734 – 3738 (AUG 2019)

Upcoming Events

22 nd March – 4 th April 2020	CERN Accelerator School “RF for Accelerators”, Kaunas, Lithuania
23 rd – 27 th March 2020	AVA International School on Precision Studies, Prague, Czech Republic
9 th - 14 th May 2020	PTCOG59, Taipei, Taiwan
10 th – 15 th May 2020	IPAC20, Caen, France
30 th Aug - 4 th Sept 2020	LINAC2020, Liverpool, UK
13 th – 17 th Sept 2020	IBIC 2020, Sao Paulo, Brazil

NOTICE BOARD

DEADLINE FOR THE NEXT NEWSLETTER **12th January 2020**



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