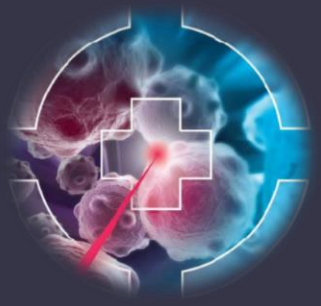


OMA Express
December 2024
Issue 21

Highlights

- Research News
- Partner News
- Events

Transforming Cancer Treatment and Beyond

A new filtering approach for range verification in proton therapy has been validated by past OMA researchers and collaborators. Using prompt gamma radiation as a predictive tool, this innovation offers clinicians greater precision in targeting tumours while minimizing damage to surrounding healthy tissue. By improving workflow efficiency and integrating sensitivity analyses, this technique marks a significant leap forward in the field of proton therapy, ensuring better patient outcomes.

Former OMA Fellow Dr Jacinta Yap and her team have developed a new beamline design that addresses limitations in current hadron therapy systems. By incorporating a "closed-dispersion arc" design with larger momentum acceptance, their work could dramatically improve the speed and precision of energy adjustments during treatment, offering a pathway to more efficient and adaptable cancer therapies.

The integration of in-vivo monitoring systems using advanced tracking technology, as developed by OMA alumni, is further enhancing the precision of ion-beam radiotherapy. Clinical trials at leading facilities such as Heidelberg's HIT center demonstrate the power of combining secondary radiation tracking with real-time treatment adjustments, setting the stage for broader applications across different tumour types and ion species.

All these innovations are described in this issue of the OMA Express, which I hope you will enjoy.

Furthermore, I am delighted to share with you a brand-new film about my own QUASAR Group that gives an insight into our current research activities.

Finally, I am absolutely thrilled to announce that Liverpool will host IPAC'29, the world's largest particle accelerator conference, between 20 – 25 May 2029. This event will spotlight the North-West's legacy as the birthplace of accelerators and bring world-class science to our vibrant city, supported by an inspiring outreach program. So please mark this in your calendars!

Prof Carsten P Welsch
Editor

Research News

Experimental validation of a filtering approach for range verification in proton treatment planning

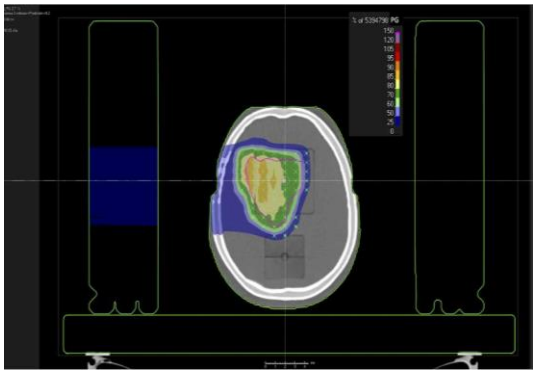
A novel approach to verifying the accuracy of proton therapy treatments has been successfully validated, offering potential improvements in both treatment precision and workflow efficiency. The new method, based on an analytical algorithm for predicting prompt gamma (PG) radiation, was recently tested in a study published in Physics in Medicine & Biology by a team of researchers including OMA scientists **Liheng Tian** and **Katia Parodi**, from Ludwig-Maximilians-Universität München, and **Julien Smeets** from Ion Beam Applications.

Proton therapy relies on accurate range verification to ensure that the radiation reaches the intended area without affecting surrounding healthy tissue. The use of PG radiation, generated when protons interact with tissue nuclei, offers a promising technique for verifying this range during treatment.

The study introduces a new PG prediction algorithm based on a filtering formalism, which has been implemented in RayStation, a widely used treatment planning system. The algorithm was benchmarked against another well-established prediction tool, REGGUI, and validated using experimental data. Results showed that the filtering algorithm produces highly accurate predictions, with a mean deviation of just 1.5 mm compared to experimental measurements, while also requiring significantly less computational time than REGGUI, which had a mean deviation of -0.6 mm. The larger mean deviation was because the authors did not have the exact beam model of the facility in RayStation.

In addition to the algorithm's validation, the study proposes a new workflow that improves data selection by using quality criteria and analytical methods to choose irradiation spots with the best PG profile accuracy. This approach also incorporates sensitivity and specificity analyses, providing clinicians with key information to assist in treatment decisions, such as whether to interrupt irradiation or adjust spot selection.

This new workflow and the filtering prediction method offer a promising step forward in making proton therapy more precise and efficient, ensuring better outcomes for patients undergoing this advanced cancer treatment.



Axial image of the phantom and a cross-section of the Planning Target Volume (in pink color) shown in a research version of RayStation. Also shown is the sum of predicted Prompt Gamma Emission by the filtering approach with an energy selection window of 3–6 MeV.

Full article:

*Huang, Ze; Tian, Liheng; Janssens, Guillaume; Smeets, Julien; Xie, Yunhe; Teo, Boon-Keng Kevin; Nilsson, Rasmus; Traneus, Erik; Parodi, Katia; Pinto, Marco, "*An experimental validation of a filtering approach for prompt gamma prediction in a research proton treatment planning system", PHYSICS IN MEDICINE AND BIOLOGY 69(15), 155025 (AUG 2024)
https://doi.org/10.1088/1361-6560/ad6116

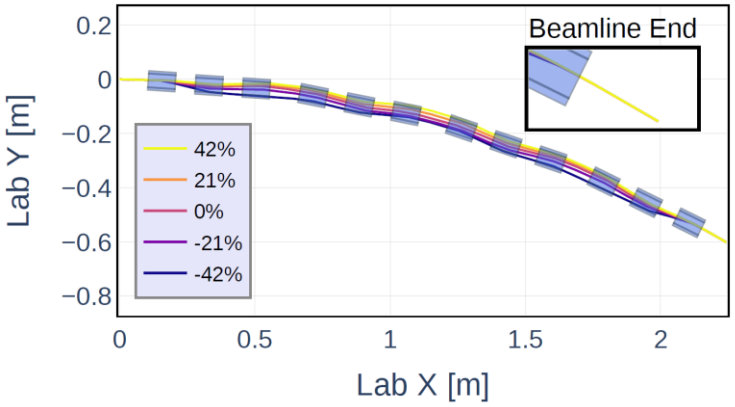
Large energy acceptance beamlines for hadron therapy

Former OMA fellow **Jacinta Yap** and colleagues from the Universities of Melbourne and Manchester have developed a new beamline design that could improve the efficiency of hadron therapy treatments. The new design addresses a limitation in current beam delivery systems, which have a narrow momentum acceptance and slow energy switching times.

In hadron therapy, the ability to quickly adjust the energy of the beams is crucial for delivering precise doses to tumours. However, the momentum acceptance of existing beamlines is typically small (less than 1%), which can limit the speed of energy switching. To address this, the researchers have proposed a "closed-dispersion arc" design with larger momentum acceptance, which could allow for faster adjustments during treatment.

The design, which uses Fixed Field Accelerator (FFA) optics, has been developed for proton beams with a momentum acceptance of up to +42% as part of the Technology for Ultra-Rapid Beam Operation (TURBO) project at the University of Melbourne. The team also introduced an algorithm for constructing permanent magnet Halbach arrays, which generate the necessary magnetic fields for this low energy test beamline, with a high degree of accuracy.

While this design has yet to be demonstrated for a clinical setting, the researchers believe scaling up this concept could be a step toward more efficient proton therapy delivery systems. Further development and testing will be needed to fully assess the feasibility of this technology for medical use.



Trajectories in the optimized arc.

Full article:

Steinberg, A. F.; Appleby, R. B.; Yap, J. S. L.; Sheehy, S. L., "Design of a large energy acceptance beamline using fixed field accelerator optics", PHYSICAL REVIEW ACCELERATORS AND BEAMS 27(7), 071601 (JUL 2024)
https://doi.org/10.1103/PhysRevAccelBeams.27.071601

New Method Improves Image Quality in Spectral Photon-Counting CT Imaging

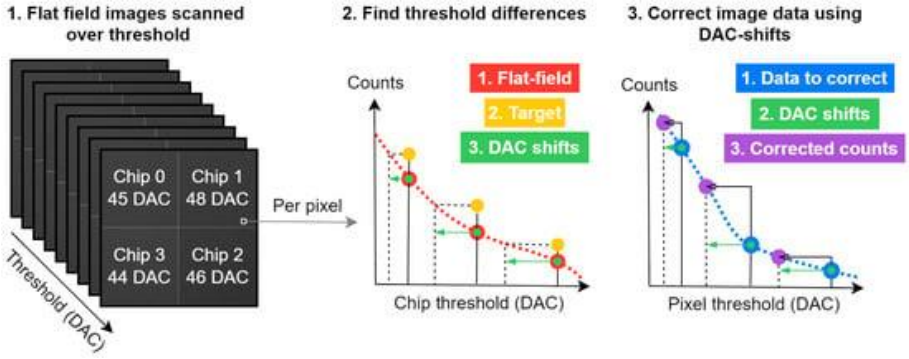
Former OMA fellow **Navrit Bal** and colleagues from Aarhus University have introduced a novel post-processing method to enhance the quality of spectral photon-counting cone-beam computed tomography (CT) imaging, which is often challenged by pixel response inconsistencies and resulting image artefacts, such as rings. The new approach, called digital-to-analogue converter (DAC)-shifting, explicitly addresses these pixel response issues, leading to significant improvements in image clarity and accuracy.

Spectral photon-counting CT imaging, which captures detailed images by detecting X-ray photons at different energy levels, can suffer from noise and artefacts due to variations in individual pixel responses. Existing methods to correct for these issues typically rely on calibration techniques, such as signal-to-thickness calibration (STC), or post-processing corrections that do not directly account for pixel response.

The DAC-shifting method, as presented in a recent study, measures pixel responses using flat-field images and then adjusts the projection data to correct these inconsistencies. The technique was evaluated using a series of spectral photon-counting CT scans of a phantom with varying density inserts and iodine K-edge imaging. Results showed that DAC-shifting was highly effective in reducing CT-number variation in homogeneous materials, achieving an average reduction of 47.4%, compared to the more limited 13.7% reduction seen with STC.

In addition to improving image uniformity, DAC-shifting enhanced iodine K-edge imaging by producing sharper attenuation peaks and more consistent CT values. This could have important implications for more accurate iodine concentration quantification in clinical applications, such as cancer imaging.

The findings suggest that DAC-shifting is a robust and effective method for improving spectral photon-counting CT imaging, with potential for widespread use in both research and clinical settings.



Process of DAC-shifting (more information in the article).

Full article:

Bal, Navrit Johan Singh; Ragupathy, Imaiyan Chitra; Tramm, Trine; Nijkamp, Jasper, "A Novel and Reliable Pixel Response Correction Method (DAC-Shifting) for Spectral Photon-Counting CT Imaging", TOMOGRAPHY 10(7), 1168-1191 (JUL 2024) https://doi.org/10.3390/tomography10070089

New Deep Learning Model Improves Prostate Cancer Diagnosis by Enhancing MRI Segmentation

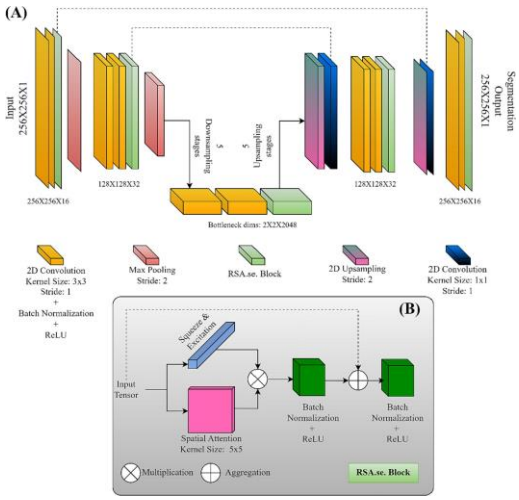
A new deep learning (DL) model called ResQu-Net has demonstrated significant improvements in the segmentation of the peripheral zone of the prostate, a critical region for the diagnosis and treatment of prostate cancer. Prostate cancer, which is one of the leading causes of cancer in men, often arises in the peripheral zone, making accurate delineation of this area on MRI scans crucial for effective clinical decision-making.

The peripheral zone is notoriously difficult to segment accurately due to its complex anatomical structure, and until now, no DL algorithms have been specifically tailored to this task. The ResQu-Net model, however, has been designed to address these challenges and deliver more precise results.

In a recent study, a team of researchers including former OMA fellow **Charalampos Kalantzopoulos** tested ResQu-Net on three publicly available datasets and compared it to six other popular DL segmentation models, including Attention U-Net, Dense2U-Net, and U-Net. The results were compelling: ResQu-Net outperformed the other models in accurately segmenting the peripheral zone across various anatomical regions, including the apex, midgland, and base of the prostate.

Quantitative assessments showed that ResQu-Net improved segmentation performance by more than 5% in terms of Dice Score (a measure of overlap between predicted and true boundaries) and reduced the 95% Hausdorff Distance (a measure of the greatest distance between predicted and true boundaries) by 1.87 mm, compared to the other models. Qualitative evaluation, including analysis of feature maps, also demonstrated ResQu-Net's superior ability to match the ground truth annotations with greater precision.

These findings suggest that ResQu-Net could play a key role in addressing one of the major challenges in prostate cancer imaging, leading to better clinical outcomes by improving the accuracy of detection and treatment planning. The model's ability to provide more accurate and reliable segmentation of the peripheral zone could significantly aid radiologists and clinicians in making more informed decisions for patient care.



ResQu-Net model (Fig. A) consists of an encoder decoder network which assists on the forward passing of information, being capable of retaining the spatial information of the prostatic zone by utilizing residual connections. The novel RSA.se block (Fig. B) involves the parallel connection of Squeeze and Excitation (SE) and Spatial Attention (SA) layers, along with the input's residual connection, to propagate information smoothly.

Full article:

Zaridis, Dimitrios I.; Mylona, Eugenia; Tachos, Nikolaos; Kalantzopoulos, Charalampos N.; Marias, Kostas; Tsiknakis, Manolis; Matsopoulos, George K.; Koutsouris, Dimitrios D.; Fotiadis, Dimitrios I., "ResQu-Net: Effective prostate's peripheral zone segmentation leveraging the representational power of attention-based mechanisms", BIOMEDICAL SIGNAL PROCESSING AND CONTROL 93, 106187 (JUL 2024)
https://doi.org/10.1016/j.bspc.2024.106187

Design report of an in-vivo monitoring system for ion-beam radiotherapy made of 28 Timepix3 detectors published in Scientific Reports

For the past four years, former OMA fellow **Laurent Kelleter** has been working at the German Cancer Research Centre (DKFZ, Heidelberg, Germany) on a tracking system that is being used as an in-vivo monitoring system in ion-beam radiotherapy. The design and performance reports has just been published in Scientific Reports.

By exploiting the information carried by secondary radiation that is always produced during ion-beam therapy, the tracking system aims to improve the treatment accuracy. This is done by triggering a control CT of the patient if the observed difference between the secondary radiation fields of two treatment fractions cross a pre-defined threshold.

In the report, the system's spatial resolution for individual particles is quantified as 4 mm along the beam axis. Moreover, it can easily resolve sub-millimetre beam range shifts that spread over a larger area.

For now, the tracking system is being used in the InViMo (in-vivo monitoring) clinical trial at the Heidelberg Ion Beam Therapy Centre (HIT, Heidelberg, Germany) for patients suffering from cancer near the skull base and treated with carbon-ion radiotherapy. Future plans are to expand the application to other tumour indications in the head as well as to other ion species (helium and oxygen).

Dr Laurent Kelleter with the InViMo system at HIT. (Credit: L. Kelleter)

Full article:

Kelleter, L; Marek, L; Echner, G; Ochoa-Parra, P; Winter, M; Harrabi, S; Jakubek, J; Jäkel, O; Debus, J; Martisikova, M, "An in-vivo treatment monitoring system for ion-beam radiotherapy based on 28 Timepix3 detectors", SCIENTIFIC REPORTS 14, 15452 (2024). https://doi.org/10.1038/s41598-024-66266-9

Partner News

International School on Innovative Radiotherapy Techniques in Pavia

From September 16 to 20, 2024, the National Center for Oncological Hadrontherapy (CNAO) hosted the second edition of the International School on Innovative Radiotherapy Techniques (ISIRT). This event, organized in collaboration with the Department of Physics at the University of Pavia, the Laboratory of Nuclear Energy and Applications (LENA), and the Pavia section of the National Institute of Nuclear Physics (INFN), brought together graduate students interested in advanced oncological therapies, including hadrontherapy, Boron Neutron Capture Therapy (BNCT), radionuclide therapy, and magnetic hyperthermia.

The main goal of ISIRT was to provide an in-depth overview of the physical, biological, and medical principles underlying these innovative treatment techniques, with a focus on both their fundamental concepts and clinical applications.

The first day of the school covered introductory topics, while the second day, hosted at CNAO, was dedicated to hadrontherapy. Participants attended lectures on radiobiology, imaging, and clinical applications, delivered by leading experts in the field. On the third day, the focus shifted to BNCT, with sessions covering its basic principles as well as its physical, chemical, preclinical, and clinical aspects. The fourth day explored the production of radioisotopes for medical use and delved into the key concepts of magnetic hyperthermia.

The final day featured a lecture on "FLASH therapy," an emerging technique involving ultra-fast radiation dose delivery. This was followed by a discussion on the potential of applying BNCT to Alzheimer's disease, as well as presentations on the clinical uses of radionuclides.

The school concluded with a guided tour of LENA, where participants had the opportunity to visit the "Triga Mark II" research reactor and other advanced research facilities, which was a highlight of the week for many.

Approximately 25 students from various countries attended the school, which was held in person with lectures delivered in English. The event benefited from the expertise of both national and international specialists from institutions such as the University of Pavia, University of Pisa, Granada University, University Hospital Birmingham, Okayama University, and several research centers and clinical institutions, including CNAO, INFN, CNEA-Argentina, CSIC-Barcelona, CNR-Florence, CHUV-Lausanne, and Policlinico San Matteo.

CNAO brings medical physics research to the classroom

Monica Necchi, physicist in charge of CNAO's expansion project, participated as a speaker in the project "An hour with the researcher", carried out for the 5th year secondary school students at the Liceo Edoardo Amaldi in Alzano Lombardo (Bergamo).

The event was part of a regular series of activities carried out in Italy, where high schools promote scientific research in a variety of ways. The Liceo Edoardo Amaldi organises every year online talks with distinguished Italian scientists to share their vision of research, their day to day activities, their successes, and their obstacles as well.

Since their visit of to CNAO a few years ago, the Liceo regularly invites Monica to talk about CNAO, and the applications of physics to the clinic, as well as to share with the students the main milestones in her career.

Monica talked to them about her own career, from the high-energy physics to the physics applied to medicine.

Students had the opportunity of reading Monica's CV some days before the event, so that twenty minutes were devoted to questions and answers. Monica says: "The Q&A session is the most exciting moment for me, because they reach my soul asking why I made some choices in my life and which are still my dreams…"

She left to the students a take home message: "No matter what you would like to do in your life, if it's not what your family planned for you! Follow your passion and your heart and you will love what you do!"

Monica Necchi addressing the students via video link.

MedAustron gathers global particle therapy elite for the "2nd World Forum on Particle Therapy"

Following an initiative by the MedAustron Ion Therapy and Research Center, 80 experts in radiation therapy with protons and carbon ions came together in Krems to set the strategic course for the future of this form of therapy at the second "World Forum on Particle Therapy".

The first edition of the World Forum on Particle Therapy (WFPT) was a great success in 2018. The format was a novelty, as it enabled in-depth discussions and exchanges on a global level about the further development of this form of therapy for the first time. The second edition of the WFPT was once again enthusiastically received by the global community: 80 decision-makers – mainly radiation oncologists, but also medical physicists and industry representatives – from 4 continents (Europe, the USA, Asia and Australia) accepted MedAustron's invitation to Austria.

In six panel discussions, the participants addressed the global status of particle therapy and the most pressing issues of this high-precision cancer therapy:

What is the latest clinical and medical evidence on particle therapy and for which types of cancer are there treatment concepts?

How can collaborations be realized on an international level, how can hurdles be removed and what is the most promising design for international clinical trials?

The potential of particle therapy can only be realized through further technological innovation. Can the collaboration between academic institutions and industry be optimized?

Particle therapy is increasingly showing physical and radiobiological properties that separate it from conventional radiotherapy. What possibilities of influencing and activating the body's own immune system and thus the possibilities of integrating particle therapy with immunotherapy in the future are promising?

How can access to particle therapy be improved for patients in different countries?

Eugen B. Hug, Medical Director of MedAustron and initiator of the WFPT summarized the event: "With the '2nd World Forum on Particle Therapy', MedAustron has once again opened up a space that conventional conferences cannot offer, and I am very pleased with how actively and openly all participants used it and how creative approaches to solving the challenges were developed. Now it is time to seize the momentum of the event: we will publish our findings together and I am confident that all participants will take them back to their institutes and incorporate them into clinical practice and research."

The venue for the WFPT was the Karl Landsteiner University of Health Sciences in Krems, a close cooperation partner of MedAustron in the Lower Austrian Oncology Research Network and academic home of the Department of General and Translational Oncology and Hematology, which also

includes the two departments of Radiation Oncology and Medical Physics. These are each headed by MedAustron experts.

The MD Anderson Cancer Center and the Mayo Clinic, two of the world's most renowned US clinics, also acted as co-organizers of the "2nd World Forum on Particle Therapy".

In total, over 400,000 patients worldwide have already been treated with ion or particle therapy. The majority of these have been irradiated with protons, just under 15% with carbon ions – a ratio that also reflects the availability of the necessary equipment. Around 100 therapy centers worldwide currently offer particle therapy as a cancer treatment method, most of which only use protons. There are only six combined facilities for treatment with different types of particles worldwide, of which MedAustron is one.

The WFPT was supported by the State of Lower Austria, Karl Landsteiner University of Health Sciences, Ion Beam Applications (iba), RaySearch Laboratories, Leo Cancer Care, medPhoton, the Austrian Center for Medical Innovation and Technology (ACMIT), ecoplus Technopol Krems and Life Science Austria (LISA).

Participants in the 2nd World Forum on Particle Therapy

Article reproduced from: https://www.medaustron.at/en/beitrage/medaustron-gathers-global-particle-therapy-elite-for-the-2nd-world-forum-on-particle-therapy/

Tumour irradiation, individualised daily

In the treatment of cancer patients, irradiation can be adapted anew each day to the position of the tumour and conditions in the body. Researchers at the Paul Scherrer Institute PSI have now, for the first time, integrated such a workflow into everyday clinical practice in proton therapy – an important step in the individualisation of therapy. The study appeared in the scientific journal Physics in Medicine and Biology.

Every day, our body is a little bit different. The intestines are sometimes more full, sometimes less; sometimes there's more air rumbling in there, sometimes less. Yesterday the nose was clear – today you have to blow your nose often, and the sinuses are full of mucus. Not to mention that many people lose or gain weight over time.

Most of the differences that can be seen from one day to another are slight and occur on a scale of millimetres. "But for cancer patients who are irradiated with protons, even such small changes can have significant effects on the optimal radiation dose," says Francesca Albertini, medical physicist at PSI's Centre for Proton Therapy. More or less mucus, air, musculature, or fat – all that should be taken into account in calculating the treatment plan. In a worldwide first, PSI researchers have now succeeded for the first time in integrating this approach into daily clinical practice. This latest pioneering achievement of the Centre for Proton Therapy in Villigen will now further improve an already excellent treatment.

Exactly like photons in conventional radiation therapy, protons kill cancer cells. Protons, however, are particles with mass and charge, and the depth of their penetration into tissue is very precisely determined by physics. On the way through the body, they lose very little of their energy and release most of it into their target, the tumour – where they literally get stuck.

To ensure that the tumour is irradiated as completely as possible and that the surrounding tissue is protected, patients are scanned with computer tomography (CT) before the start of proton therapy. A treatment plan is drawn up: The doctor calculates which area of the body will be precisely scanned in three dimensions with the proton beam, as well as how energetic the beam needs to be.

During a course of proton therapy, the tumour is irradiated on five days of the week, usually for two to seven weeks. If the treatment plan is newly adjusted every day to the patient's current anatomy, the irradiation will be even more precisely targeted.

With the new workflow, a low-dose CT scan is taken before each irradiation. The radiation dose of the proton therapy is then newly calculated on the basis of the current anatomy as well as the positioning of the patient on the treatment couch. For that, Francesca Albertini and her team of PSI researchers developed a software program that adapts the treatment plan to the current situation as recorded in a CT image. After that, the irradiation proceeds immediately according to the new plan.

"In principle, such a procedure brings nothing but advantages," Francesca Albertini says. "We can ensure that the target volume – that is, the tumour – is hit precisely. Thus, the overall radiation load is reduced, since healthy tissue is less exposed."

A possible disadvantage could be that, overall, more time passes during each application, meaning that patients might need to endure a longer time on the couch. In a worst-case scenario, fewer people could be treated per day, so fewer would benefit from proton therapy. “For us it was therefore of the utmost importance to optimise the speed of the process,” Albertini stresses. And they were successful: In all, irradiation including adaptation of the treatment plan lasted on average only four minutes longer than without the new procedure.

In a first feasibility study, which now appears in the journal Physics in Medicine and Biology, Francesca Albertini and her team of PSI researchers applied the new procedure to the treatment of five patients being irradiated against tumours in bony regions of the body, such as the skull and the base of the skull. In these regions, fewer daily changes are to be expected than, for example, in the abdomen, where the filling of the intestines and bladder has a major influence. In a next step, the researchers will now also establish their workflow for tumour types that occur in such regions of the body.

An additional CT scan per day does in fact mean an increase in radiation exposure. “But we assume that the risk of secondary cancers triggered solely through the irradiation is not increased by the new process,” says Damien Weber, head and chief physician of the Centre for Proton Therapy. “On the contrary: The risk is actually reduced.” Since the workflow makes proton therapy more precise overall, this ultimately means a net reduction in radiation exposure. In addition, a particularly low-radiation technique is used for the daily CT scans.

“In a few years, all proton therapy centres in the world will probably implement such daily adaptations,” says Antony John Lomax, group head of Medical Physics and co-author of the study. He suspects that commercial solutions may soon become available, such as software that makes adjustments to the treatment plan. “The fact that we are the first to apply such a workflow to everyday clinical practice is an important step in that direction.”

Gantry 3 at the Center for Proton Therapy at PSI. With the help of this rotating treatment apparatus, cancer patients are irradiated with protons to destroy tumours. © Scanderbeg Sauer Photography

Article reproduced from https://www.psi.ch/en/news/media-releases/tumour-irradiation-individualised-daily

Professor Welsch contributes to 2024 KoWi Annual Conference on EU Research & Innovation Funding

The 2024 KoWi Annual Conference on EU Research & Innovation Funding is at the heart of KoWi's event schedule every year. The conference provides an excellent forum for exchanging information regarding EU Research and Innovation Funding. This year, it was hosted by the Ludwig Maximilian University and the Technical University Munich between 4 – 6 June 2024.

Professor Carsten Welsch has been a member of the KoWi Advisory Board since 2016. The board meets annually to review the activities of KoWi and make recommendations on its strategic development.

In addition, Prof Welsch had the pleasure of joining a high-level panel on knowledge valorisation, moderated by the KoWi Head Dr Torsten Fischer and involving Dr Michiel Scheffer, President of the European Innovation Council and SMEs Executive Agency (EISMEA), Prof Gerhard Kramer, TUM Vice President, and Prof Dorit Schumann, President of Trier University.

The driving question of the panel was: Are we already on the right path to a European Innovation Area? The panel discussed knowledge valorisation in an all-round view on innovation policy. It recognized that knowledge valorisation plays a central role in the research policy debate in Germany and the EU and that there is already a wide range of funding and support for the valorisation of research results, especially in Horizon Europe. It became clear in the discussion that knowledge transfer and the assessment of research impact across various dimensions will affect research and research policy even more in the future.

The Annual Conference also featured a number of hands-on workshops on diverse topics ranging from Research Security and MSCA Joint Doctorates all the way to Research and Innovation Partnerships.

A get-together on the first day and an evening reception, hosted by the Bavarian State Ministry for Science and Arts in the Pinakothek of Modern Art on the Wednesday, completed an impactful program that stimulated many interesting discussions.

More information can be found at www.kowi-bundestagung.de

Panel on knowledge valorisation, image courtesy KoWi.

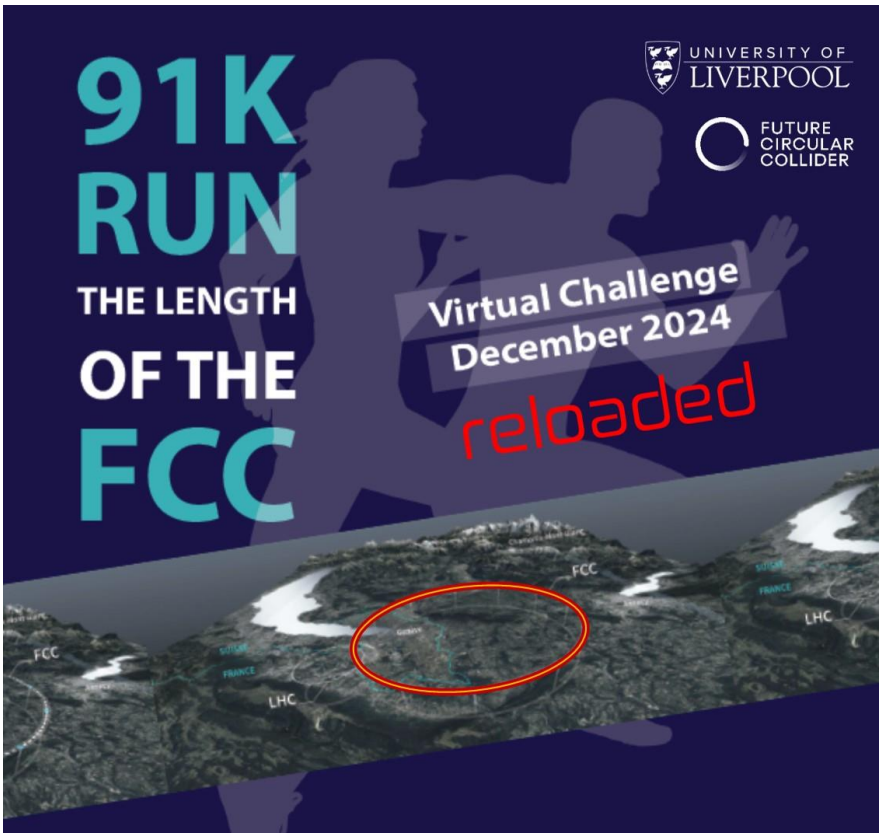
Events

FCC Virtual challenge RELOADED

The QUASAR Group at the University of Liverpool is re-launching "Run the Length of the Future Circular Collider," a virtual fitness challenge designed to help you reach your health goals while exploring the exciting world of physics!

This virtual challenge invites you to run or walk the distance of the Future Circular Collider, a proposed accelerator for the post-LHC era that would span an astonishing 91km circumference, at your own pace, between 1 and 31 December 2024. You can walk or run anywhere, tracking your progress and submitting your results through our easy-to-use registration website:

https://shorturl.at/0ISV9



Selected Publications

Kelleter, L; Marek, L; Echner, G; Ochoa-Parra, P; Winter, M; Harrabi, S; Jakubek, J; Jäkel, O; Debus, J; Martisikova, M, **"An in-vivo treatment monitoring system for ion-beam radiotherapy based on 28 Timepix3 detectors"**, SCIENTIFIC REPORTS 14, 15452 (2024). https://doi.org/10.1038/s41598-024-66266-9

Shaikh, Saad; Escribano-Rodriguez, Sonia; Radogna, Raffaella; Kelleter, Laurent; Godden, Connor; Warren, Matthew; Attree, Derek; Saakyan, Ruben; Mortimer, Linda; Corlett, Peter; Warry, Alison; Gosling, Andrew; Baker, Colin; Poynter, Andrew; Kacperek, Andrzej; Jolly, Simon, **"Spread-out Bragg peak measurements using a compact quality assurance range calorimeter at the Clatterbridge cancer centre"**, PHYSICS IN MEDICINE AND BIOLOGY 69(11), 115015 (JUN 2024) https://doi.org/10.1088/1361-6560/ad42fd

Steinberg, A. F.; Appleby, R. B.; Yap, J. S. L.; Sheehy, S. L., **"Design of a large energy acceptance beamline using fixed field accelerator optics"**, PHYSICAL REVIEW ACCELERATORS AND BEAMS 27(7), 071601 (JUL 2024) https://doi.org/10.1103/PhysRevAccelBeams.27.071601

Bal, Navrit Johan Singh; Ragupathy, Imaiyan Chitra; Tramm, Trine; Nijkamp, Jasper, **"A Novel and Reliable Pixel Response Correction Method (DAC-Shifting) for Spectral Photon-Counting CT Imaging"**, TOMOGRAPHY 10(7), 1168-1191 (JUL 2024) https://doi.org/10.3390/tomography10070089

Zaridis, Dimitrios I.; Mylona, Eugenia; Tachos, Nikolaos; Kalantzopoulos, Charalampos N.; Marias, Kostas; Tsiknakis, Manolis; Matsopoulos, George K.; Koutsouris, Dimitrios D.; Fotiadis, Dimitrios I., **"ResQu-Net: Effective prostate's peripheral zone segmentation leveraging the representational power of attention-based mechanisms"**, BIOMEDICAL SIGNAL PROCESSING AND CONTROL 93, 106187 (JUL 2024) https://doi.org/10.1016/j.bspc.2024.106187

Huang, Ze; Tian, Liheng; Janssens, Guillaume; Smeets, Julien; Xie, Yunhe; Teo, Boon-Keng Kevin; Nilsson, Rasmus; Traneus, Erik; Parodi, Katia; Pinto, Marco, **"An experimental validation of a filtering approach for prompt gamma prediction in a research proton treatment planning system"**, PHYSICS IN MEDICINE AND BIOLOGY 69(15), 155025 (AUG 2024) https://doi.org/10.1088/1361-6560/ad6116

Other Events

2nd – 6th May 2025	ESTRO, Vienna (Austria)
1st – 6th June 2025	16th International Particle Accelerator Conference (IPAC'25), Taipei (Taiwan)
2nd – 7th June 2025	63rd Annual PTCOG Conference, Buenos Aires (Argentina)
7th – 11th September 2025	14th International Beam Instrumentation Conference (IBIC'25), Liverpool (UK)
10th – 12th December 2025	Flash Radiotherapy and Particle Therapy Conference (FRPT 2025), Prague (Czech Republic)
20th – 25th May 2029	20th International Particle Accelerator Conference (IPAC'29), Liverpool (UK)

www.oma-project.eu

Editor
Prof Carsten P. Welsch
c.p.welsch@liverpool.ac.uk

Co-editor
Dr Ricardo Torres
r.torres@liverpool.ac.uk

Co-editor
Alexandra Welsch
a.welsch@liverpool.ac.uk

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 675265.