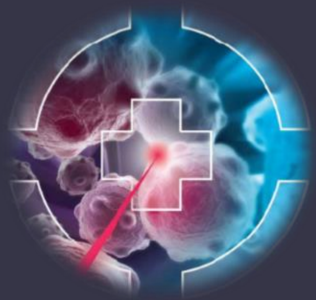


OMA Express
July 2020
Issue 13

Highlights

- Enhancing particle therapy accuracy
- Preparation of a radiobiology beam line at CNA
- Final report of OMA submitted to the European Commission
- Partner News
- Vacancies

OMA….was and remains 'excellent'

Who would have thought at the time our previous newsletter was published that a global pandemic would soon hit us and that we would all have to go in some sort of lockdown?! Whilst we are slowly recovering and making plans for the future, this OMA Express will hopefully help you get some sort of "normal life" back in your inbox.

Our previous *OMA Express* celebrated the end of a very successful project. Across the network, we have established close connections and are now planning joint research activities on the basis of our OMA activities. In this issue, you will find more details about the submission of our final report and how this very impressive document was put together.

Just this week, we concluded the formal processes. I am delighted to say that our report was fully accepted and that many aspects of our project were found to be of excellent quality.

It makes me very proud to see that our results are so nicely recognized and am sure that this will motivate our future R&D.

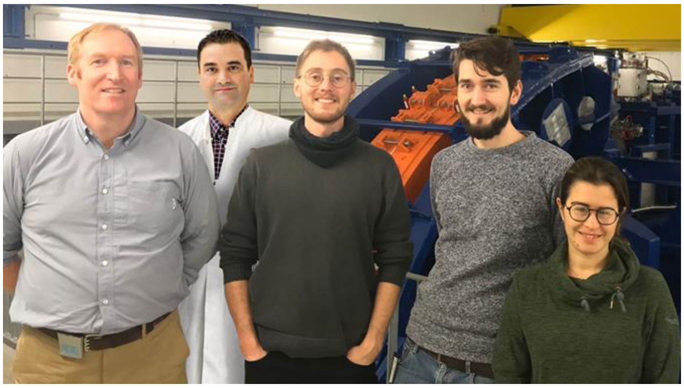
Results from our final conference at CNA in Seville, Spain last year have now been published in a Focus Issue of the European Journal for Medical Physics (EJMP). You can already access many of the articles via the May, June, July and August issues – more papers will follow in the near future. Another excellent result from our network. Many thanks to all of you who contributed!

With my very best wishes in these testing times.

Prof. Carsten P. Welsch,
Coordinator

Research News

Enhancing particle therapy accuracy



*Members of the research team at the heavy ion gantry of the Heidelberg Ion-Beam Therapy Centre.**

Months after the official end of the OMA project, the results keep having an impact. OMA Fellow Laurent Kelleter managed to publish his theoretical work on the description of proton depth-light curves in plastic scintillator in the journal Medical Physics [1]. The model combines Bortfeld's formula for a depth-dose curve with Birks' formula for light quenching in scintillator. The resulting 'quenched Bragg curve' allows measuring the proton beam range and the light quenching (Birks' constant) from a depth-light curve in a scintillator. The model is particularly valuable in the case of low spatial detector resolution. This is also the case for the range telescope developed by Laurent and his supervisor, Dr Simon Jolly, at University College London (UCL) for fast proton range quality assurance measurements.

Moreover, the range telescope has the potential to be used with therapeutic ion beams. A recent idea is to add a small fraction of helium ions to a carbon ion beam, with the aim of online treatment monitoring. At the same energy per nucleon, helium ions have about 3x the range of carbon ions, potentially enabling the simultaneous treatment (with carbon ions) and treatment monitoring (helium). A collaboration was set up between UCL and DKFZ (German Cancer Research Centre, Heidelberg, Germany) to explore the potential of a mixed helium/carbon beam in experiments with both plastic and anthropomorphic phantoms.

The experiments were carried out at the Heidelberg Ion Beam Therapy centre (HIT). The residual rage of the helium ions exiting the phantom was measured with the UCL range telescope. The results were published in Physics in Medicine and Biology [2] and picked up by an article in Physics World [3].

[1] Laurent Kelleter and Simon Jolly, "A mathematical expression for depth-light curves of therapeutic proton beams in a quenching scintillator", Med. Phys. (2020). https://doi.org/10.1002/mp.14099

[2] Lennart Volz, Laurent Kelleter, Stephan Brons, Lucas N Burigo, Christian Graeff, Nina Isabell Niebuhr, Raffaella Radogna, Stefan Scheloske, Christian Schömers, Simon Jolly and Joao Seco, "Experimental exploration of a mixed helium/carbon beam for online treatment monitoring in carbon ion beam therapy", Physics in Medicine & Biology 65(5) (2020). https://doi.org/10.1088/1361-6560/ab6e52

[3] Tami Freeman, "Mixed ion beams could enhance particle therapy accuracy", Physics World 21 February 2020. https://physicsworld.com/a/mixed-ion-beams-could-enhance-particle-therapy-accuracy/

**Left to right: Simon Jolly (UCL), Joao Seco (DKFZ), Laurent Kelleter (UCL), Lennart Volz (DKFZ) and Raffaella Radogna (UCL).*

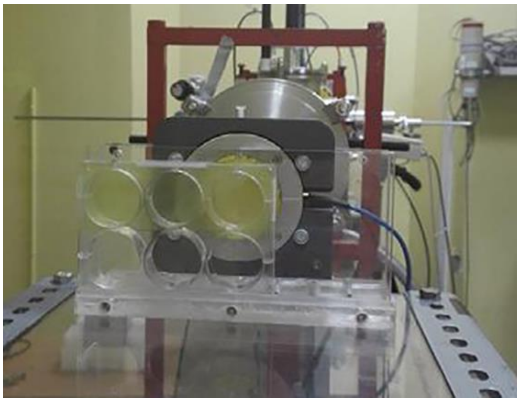
Preparation of a radiobiology beam line at CNA

In an article recently published in Physica Medica, OMA Fellow Anna Baratto-Roldán and her colleagues from the National Centre of Accelerators (CNA) and the University of Seville, Spain, have presented the radiobiology beam line designed at the 18 MeV proton cyclotron facility of CNA, to perform irradiations of mono-layer cell cultures.

The lack of accurate biological data in the Bragg peak region of proton therapy beams, makes it difficult to implement biophysically optimized treatment plans in clinical practice. In this context, low energy proton accelerator facilities provide the perfect environment to collect good radiobiological data, as they can produce high Linear Energy Transfer beams with narrow energy distributions.

To ensure that all the cells receive the same dose with a suitable dose rate, low beam intensities and broad and homogeneous beam profiles are necessary. To do so, Anna and her colleagues used an unfocused beam, broadened with a 500 µm thick aluminium scattering foil. Thus, they obtained homogeneous dose profiles, with deviations lower than 10%, over a circular surface of 35 mm diameter for an incident average energy of 12.8 MeV.

The team also developed a specific Monte Carlo application with Geant4 to simulate the beam line and the experimental setup. The code was benchmarked and validated towards measurements, reproducing with a very good agreement experimental data in what concerned both the beam energy distribution and dose profiles, with differences generally lower than 1%. Once validated, the code was used, together with an ionization chamber, for dosimetry studies, to characterize the beam and monitor the dose.



Setup for the measurement of the EBT3 film proton dose calibration curve. (Image credit CNA)

Finally, the researchers managed to irradiate successfully cultures of Human Bone Osteosarcoma cells (U2OS) at the radiobiology beam line, investigating the effects of radiation in terms of DNA damage induction.

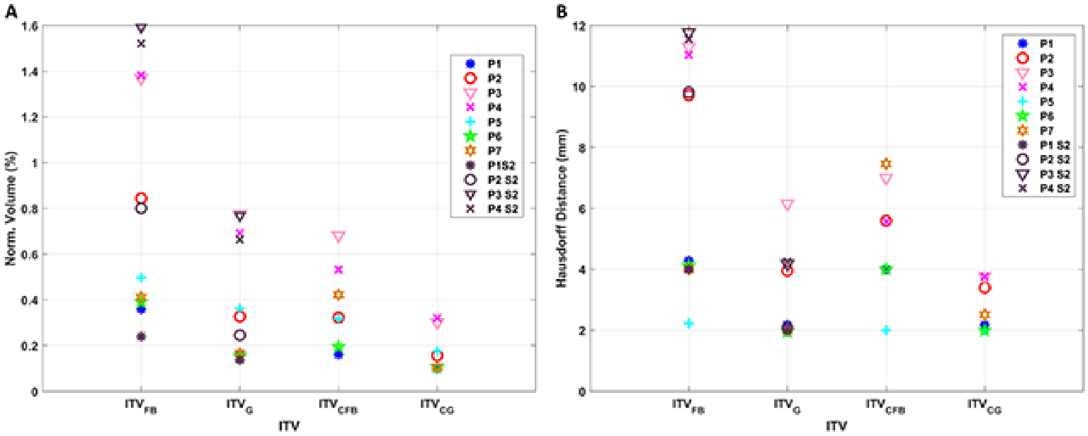
The article is part of a special issue of the European Journal of Medical Physics – Physica Medica edited on occasion of the International Conference on Medical Accelerators, organised by the OMA network in Seville (Spain) in September 2019.

The full article can be found here:

Anna Baratto-Roldán, María del Carmen Jiménez-Ramosa, Sonia Jimeno, Pablo Huertas, Javier García-López, María Isabel Gallardo, Miguel Antonio Cortés-Giraldo, José Manuel Espino, "Preparation of a radiobiology beam line at the 18 MeV proton cyclotron facility at CNA", Physica Medica 74, 19–29 (2020).

https://doi.org/10.1016/j.ejmp.2020.04.022

Quantification of organ motion in carbon ion therapy of abdominal lesions



Comparison between the generated ITVs and the GTV. A) Normalized Volume and B) Hausdorff distance. (image reprinted with permission from Elsevier)

Carbon ion radiotherapy (CIRT) has demonstrated to be a promising treatment for abdominal tumours, thanks to the advantages in terms of geometrical selectivity and radiobiological effectiveness with respect to X-ray and proton therapy. However, the potentially increased effectiveness and accuracy of CIRT may be undermined by the presence of organ motion. The motion of both tumour and nearby organs introduces geometric uncertainties into the process, leading to potential underdosage of the target region, and/or overdosage of organs at risk. Moreover, organ motion generates density changes within the beam path, leading to alteration in the planned dose distribution.

In a study recently published in Physica Medica, OMA Fellow Charalampos Kalantzopoulos and colleagues from CNAO and Politecnico di Milano have employed Magnetic Resonance Imaging (MRI) to quantify the tumour motion, and to evaluate the clinical approach based on the standard practice of 4D Computed Tomography (4DCT) for organ motion management.

Organ motion can be accounted for by defining margins based on the 4DCT data, with the definition of the so-called Internal Target Volume (ITV). However, 4D imaging reflects the anatomy at different time points during an "average" breathing cycle. In order to account for respiratory motion during treatment delivery, clinicians use strategies such as gating, which involves the irradiation within a particular phase of the patient's breathing cycle.

Recently MRI has emerged as an ideal technique for time-resolved and respiratory-correlated imaging in the framework of high precision radiation therapy. MRI provides exquisite soft tissue contrast, radiation-free imaging and high temporal resolution with fast sequences. The dose-free nature of MRI and the availability of 2D fast sequences known as cineMRI, enable multiple and extended acquisitions, accounting for cycle-to-cycle breathing variations.

In this study, Charalampos and his colleagues exploited repeated cineMRI acquisition sessions to generate an ITV margin for treatment planning in CIRT of the abdominal site. Seven patients with abdominal lesions were treated with carbon-ion therapy at CNAO. The MR scan was performed on the same day of the 4DCT acquisition. For four patients, an additional MR was acquired approximately after 1 week. The cineMRI combined with deformable image registration algorithm was used to quantify tumour motion. Afterwards, two ITVs were defined considering (1) all breathing phases (ITV_{FB}) and (2) only breathing phases within the gating window (ITV_{G}), and then compared with the clinical (4DCT-derived) ITVs (ITV_{CG} and ITV_{CFB}).

The results suggest the effectiveness of the gating procedure implemented at CNAO to compensate for organ motion, and propose a method to complement the clinical workflow with cineMRI data, as a way to quantify inter and intra-fraction respiratory motion variability without delivering additional dose to the patient.

The article is part of a special issue of the European Journal of Medical Physics – Physica Medica edited on occasion of the International Conference on Medical Accelerators, organised by the OMA network in Seville (Spain) in September 2019.

The full article can be found here:
Charalampos Kalantzopoulos, Giorgia Meschini, Chiara Paganelli, Giulia Fontana, Alessandro Vai, Lorenzo Preda, Viviana Vitolo, Francesca Valvo, Guido Baroni, "Organ motion quantification and margins evaluation in carbon ion therapy of abdominal lesions", Physica Medica 75, 33–39 (2020).
https://doi.org/10.1016/j.ejmp.2020.05.014

Detector developments at UCL

A detailed description of the detector development at University College London by OMA Fellow Laurent Kelleter has recently been published in Physics in Medicine & Biology.

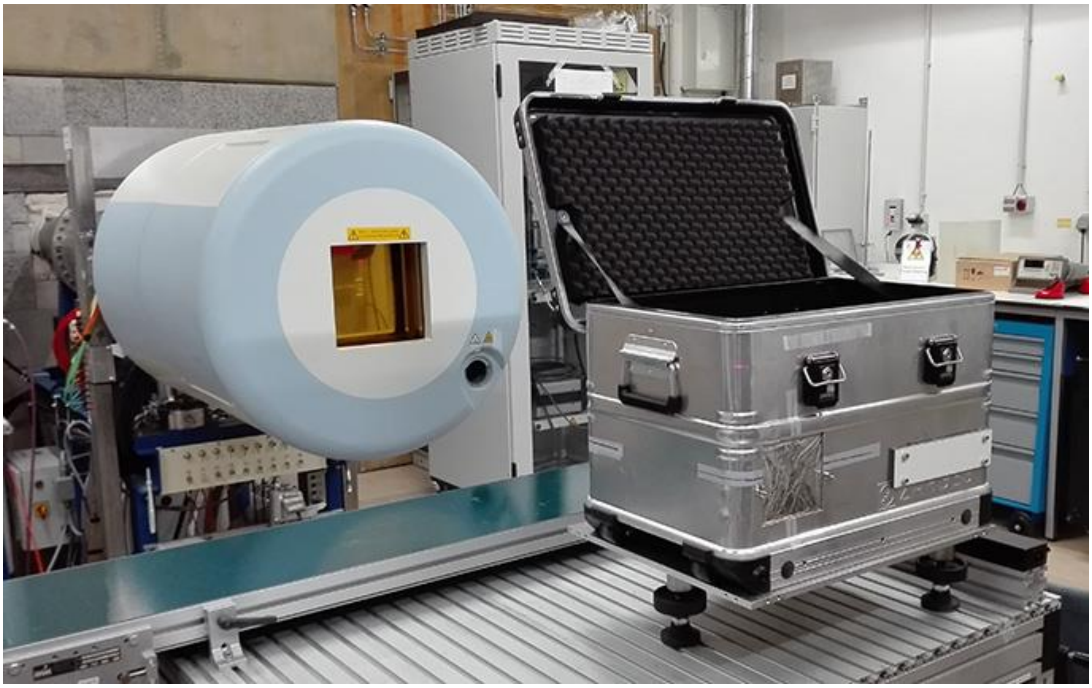
The commissioning and operation of a particle therapy centre requires an extensive set of detectors for measuring various parameters of the treatment beam. Among the key devices are detectors for beam range quality assurance (QA). Range QA measurements with standard scanning water phantoms is very time-consuming, while faster detectors are expensive and do not use water-equivalent material.

At UCL, a novel range telescope based on water-equivalent plastic scintillator and read out by a large-scale CMOS sensor was developed for fast range QA measurements. The detector is made of a stack of 49 plastic scintillator sheets with a thickness of 2-3 mm and an active area of 100 by 100 mm^2, resulting in a total physical stack thickness of 124.2 mm. This compact design avoids optical artefacts that are common in other scintillation detectors.

The range of a proton beam is reconstructed using a novel Bragg curve model that incorporates scintillator quenching effects. Measurements to characterise the performance of the prototype were carried out at the Heidelberger Ionenstrahl-Therapiezentrum (HIT, Heidelberg, Germany) and the Clatterbridge Cancer Centre (CCC, Bebington, UK).

The maximum difference between the measured range and the reference range was found to be 0.41 mm at a proton beam range of 310 mm and was dominated by detector alignment uncertainties.

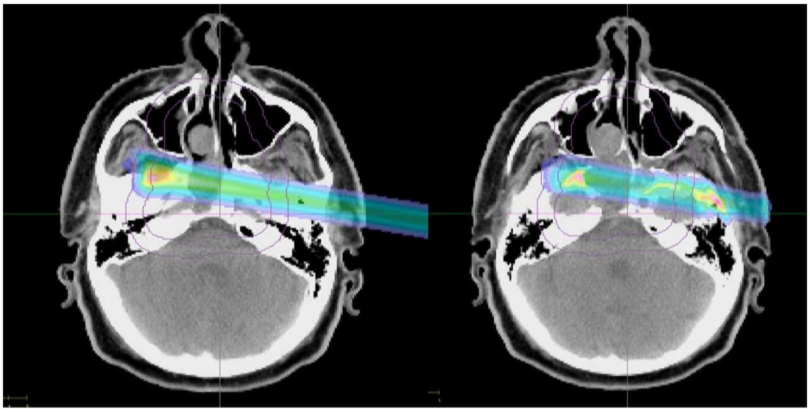
With the new detector prototype, the water-equivalent thickness of PMMA degrader blocks has been reconstructed within 0.1 mm. An evaluation of the radiation hardness proved that the range reconstruction algorithm is robust following the deposition of 6,300 Gy peak dose into the detector. Furthermore, small variations in the beam spot size and transverse beam position are shown to have a negligible effect on the range reconstruction accuracy. The potential for range measurements of ion beams was also investigated.



Range telescope developed at UCL (copyright L. Kelleter)

The full article can be found here:
Laurent Kelleter, Raffaella Radogna, Lennart Volz, Derek Attree, Anastasia Basharina-Freshville, Joao Seco, Ruben Saakyan and Simon Jolly, "A scintillator-based range telescope for particle therapy", Physics in Medicine & Biology (2020).
https://doi.org/10.1088/1361-6560/ab9415

New treatment planning approach accounting for prompt gamma range verification



Left: Dose distribution of a given pencil beam. Right: Prompt gamma emission distribution of this pencil beam. Images courtesy of LMU.

In a paper recently published in the journal Physics in Medicine & Biology, OMA Fellow Liheng Tian and colleagues from Ludwig-Maximilians-Universität München have presented a new treatment planning approach accounting for prompt gamma range verification and interfractional anatomical changes.

Prompt gamma (PG) imaging is widely investigated for spot-by-spot in vivo range verification for proton therapy, however its accuracy is affected by the number of protons delivered per pencil beam and the conformity between prompt gamma and dose distribution (PG-dose correlation).

Liheng and colleagues have used a novel approach to re-optimize conventional treatment plans by boosting a few pencil beams with good PG-dose correlation above the statistics limit for reliable PG detectability. In this work, they further explore this approach with respect to the robustness of the PG-dose correlation of each pencil beam in the case of interfractional anatomical changes.

The team created a Monte Carlo treatment plan using the analytical Matlab-based treatment planning system CERR. Then they quantified the PG-dose correlation using the originally proposed approach as well as a new indicator, which accounts for the sensitivity of individual spots to heterogeneities in the 3D dose distribution. A few pencil beams were selected for each treatment field, based on their PG-dose correlation and dose surface, and then boosted in the new re-optimized treatment plan.

All treatment plans were then fully re-calculated with Monte Carlo on CT scans of the corresponding patient at three different time points (the researchers used CTs of one prostate and one head and neck cancer patient).

The results show that the initial CERR Treatment Plans and the re-optimized Treatment Plans are comparable in terms of dose and dose averaged Linear Energy Transfer distribution for all CTs and patients.

The recommended Pencil Beams show advantages for PG based proton range verification in terms of dose shift fidelity. Besides, compared to spot aggregation, the approach shows advantages in terms of counting statistics, lateral resolution and proton range mixing.

The full article can be found here:
Liheng Tian, Guillaume Landry, George Dedes, Marco Pinto, Florian Kamp, Claus Belka and Katia Parodi, “A new treatment planning approach accounting for prompt gamma range verification and interfractional anatomical changes”, Physics in Medicine & Biology 65, 095005 (2020).
https://doi.org/10.1088/1361-6560/ab7d15

In Vivo Validation of the BIANCA Biophysical Model

Cancer ion therapy is constantly growing thanks to its increased precision and, for heavy ions, its increased biological effectiveness (RBE) with respect to conventional photon therapy.

The complex dependence of RBE on many factors demands biophysical modelling. However, up to now, only three models have been applied in clinics: the Local Effect Model (LEM), the Microdosimetric Kinetic Model (MKM), and the “mixed-beam” model.

In a work recently published in the International Journal of Molecular Sciences, OMA Fellow Giulia Aricò together with an international team of scientists from Italy, Switzerland and Germany have applied the biophysical model BIANCA (BIophysical ANalysis of Cell death and chromosome Aberrations), developed at the University and INFN of Pavia, to predict cell survival for different ions, energies, and doses.

After extensive validation in vitro, the model was applied to establish a radiobiological database of alpha and beta cell survival parameters as a function of particle type and energy.

Following interface with the FLUKA Monte Carlo transport code, for the first time, BIANCA was benchmarked against in vivo RBE data obtained by C-ion (see figure) or proton irradiation of the rat spinal cord. The latter is a well-established model for Central Nervous System late effects, which, in turn, are the main dose-limiting factors for head-and-neck tumours. Furthermore, these are the data that were used to validate the LEM model, developed at GSI and applied in clinics at HIT and MIT (Germany).

Although further benchmarking is desirable, the agreement between simulations and data suggests that BIANCA can predict RBE for C-ion or proton treatment of head-and-neck tumours. In particular, the agreement with proton data may be relevant if the current assumption of a constant proton RBE of 1.1 is revised, as it has been recently suggested by some physicists in the scientific community.

This work has provided the basis for future benchmarking against patient data, as well as the development of new databases for specific tumour types and/or normal tissues.

The full article can be found here:
Mario P. Carante, Giulia Aricò, Alfredo Ferrari, Christian P. Karger, Wioletta Kozlowska, Andrea Mairani, Paola Sala and Francesca Ballarini, “In Vivo Validation of the BIANCA Biophysical Model: Benchmarking against Rat Spinal Cord RBE Data”, International Journal of Molecular Sciences 21(11), 3973 (2020).
https://doi.org/10.3390/ijms21113973

Network News

Final report of OMA submitted to the European Commission

European Commission (Image source Pixabay)

The OMA consortium submitted its final report to the European Commission at the end of March. This submission marked the official end of a hugely successful project that has seen 38 universities, research centres, ion-beam treatment facilities, and leading industry partners, joining forces to train 15 early stage researchers in the optimization of medical accelerators. The Fellows have undertaken a 3 year-long formation plan through beyond state-of-the-art research, and an intensive programme of training events. The cross-sector interdisciplinary environment created by OMA, facilitating secondments and collaborations, has boosted the career and employability of the researchers.

Advances in the design and optimization of facilities for cancer treatment, beam imaging and treatment monitoring, as well as numerical simulations for the development of advanced treatment schemes, have resulted in 23 articles in peer-reviewed journals and 20 conference proceedings. Tireless outreach and dissemination activities have expanded the OMA network with a total of 13 new adjunct partners, and have helped to raise awareness among the general public in general, and school children in particular, of the impact of particle accelerator research on cancer diagnosis and treatment.

The over 70 pages-long final report is a comprehensive summary of all the activities and achievements of OMA, including a detailed account of the research carried out by each of the fellows, the list of publications, milestones and deliverables, a description of all the training and management activities organised, dissemination and outreach, as well as the overall impact of OMA on science and society.

Such a successful project cannot be brought abruptly to an end. That is why we have decided to continue the networking activities for as long as we can. We will continue to publish the OMA Express newsletter for at least another year (please send us your stories!) and we are planning to organise two more topical workshops as soon as the travel restrictions imposed by the current situation are lifted.

Stay tuned!

Advancements in the Optimization of Medical Accelerators

The online magazine News Medical has recently published an interview with OMA Coordinator, Prof Carsten P. Welsch.

In the interview, Prof Welsch explains the basic principles of proton beam therapy and the benefits of medical accelerator research to improve radiotherapy for patients. In particular, he reviews the success of the OMA project. Prof Welsch says: *"With OMA, we pulled a lot of the expertise that is available across Europe together and built bridges between clinical centres, research facilities where this treatment was pioneered, leading universities who produce innovative ideas, and companies that are specialised in providing these treatment facilities. In collaboration, we aimed to significantly improve treatment."*

Innovative Training Networks (ITNs) such as OMA train around 15 very highly qualified Research Fellows on the same broad research area but with distinct, individual projects. The unique features of the ITNs are based on the idea of training postgraduate students by collaborating with the best partners across Europe and taking a cohort approach.

Prof Welsch adds: *"We've seen our 15 Fellows grow from excellent undergraduate students with little background in the area of medical applications, to become leading experts in their field over a period of just three years."*

Finally, Prof Welsch expresses his view on the future of medical accelerator research and development: *"Accelerators form the backbone of current research in all scientific disciplines. If I look at strategic roadmaps like the European Strategic Facilities Roadmap, then around 50% of future science infrastructures rely on accelerator technology, one way or another."*

The whole interview can be found here: https://www.news-medical.net/news/20200611/Advancements-in-the-Optimization-of-Medical-Accelerators.aspx

Partner News

OMA partner Fistral offers free online training resources during Covid-19 lockdown

As a long-standing partner of the OMA network, Fistral Training and Consultancy Ltd is offering FREE support and resources during the Covid-19 lockdown as follows:

FREE PROJECT MANAGEMENT VIDEOS – During the Covid-19 lockdown they are offering free access to the Project Management "Espresso" videos: bite-sized 'shots' of learning. For this first set of videos they have contextualised Project Management techniques for Post-graduate Researchers, PhDs and Early Career Researchers – however the tools and techniques are equally applicable to any project. Feel free to share them with anyone – your network, colleagues, family, friends – who might be interested in learning about Project Management or needs to keep their brain working. They have released six videos, with more coming very soon. See the Espresso page for access to the videos for free.

Image Twitter @FraserFistral

FREE PROJECT MANAGEMENT MENTORING / COACHING – In addition they are also offering 'pro bono' trainer time for public health, research, or any company or customer who is involved with the Covid-19 response and would benefit from a few hours online mentoring/coaching or Project Management/Risk support. The only stipulation is that it must be a genuine project arising directly from the current crisis to provide a public health service, essential technology or research and that it must be a non-profit project or initiative. Email pauline@fistraltraining.com for more information.

These offers are available to all OMA partners plus any partner networks or organisations. In addition, feel free to circulate widely to colleagues, students, researchers, staff, friends, and loved ones in case it's of help to anyone at home or abroad during this time. Keep checking the Fistral website or follow @FraserFistral as more free "Espresso" videos on Project Management and other topics are coming soon. We hope you find them useful.

On behalf of all the Fistral Team, take care, stay safe and stay well!

The Physics of Star Wars: Creative Teaching in Times of Lockdown

Han Solo, Princess Leia, and Luke Skywalker, might have understood very well how oppressive it feels to be under lockdown when they found themselves trapped inside a trash compactor in Star Wars Episode IV: A New Hope.

The unprecedented situation created by the pandemic has changed dramatically our ways of working and going about our daily lives. In particular, the closure of schools during the lockdown has challenged parents and teachers to find innovative ways to keep children active, and many of them have turned to online resources in order to minimise the disruption to the students' education.

The Head of the Quasar Group and coordinator of the OMA network, Prof Carsten P Welsch, has stepped up to the challenge by sharing online the educational materials created for the celebrated series of Physics of Star Wars events. The ideas were published in Teaching Times, an online magazine popular among education professionals, where teachers can find classroom resources.

In the article, Professor Welsch, a declared Star Wars fan, explains how Star Wars fiction can help students to better understand the developments happening in accelerator science: "*The Physics of Star Wars provides a strong theme for engaging students with advances in accelerator science, and provides an opportunity to explore what is science and what is fiction in the famous films.*"

Based on the experiences of the Quasar group with schools in the North West, the article shares their ideas and resources to help others to explore a number of areas in the curriculum using the Star Wars theme. The aim is to show students in years 7-9 how futuristic technologies, brought to life in the movies, may potentially become possible with current developments in accelerator science.
The activities use the topics of space travel, light sabres and droids to explain concepts like the speed of light, sound propagation, and machine learning. The learning and teaching materials are described in detail so that teachers can take these ideas directly into the classroom. These include a salad-bowl accelerator, the augmented reality accelerator *acceleratAR*, and the egg-drop challenge. Additional information explain in more depth how these fundamental concepts relate to accelerator research.

The demonstrations and science content can be easily adapted to different year groups and adjusted to various class sizes – small groups benefit from giving all pupils the opportunity to gain hands-on experience, whilst larger groups are shown the demonstrations and are then engaged in discussions.

Feeling the electrostatic force around a Van de Graaff generator.

Professor Welsch says: "*I hope that these suggestions for science lessons with a Star Wars spin will prompt teachers to find exciting new ways to engage their pupils with this emerging area of science discovery.*"
The article can be found here: https://www.teachingtimes.com/the-science-of-star-wars-creative-physics-learning-in-a-galaxy-that-isnt-far-far-away/

Members of the galactic Empire, learning how to design accelerators using acceleratAR.

CNAO offers virtual tours of its facilities

The strict lockdown rules imposed in northern Italy to reduce the spread of the coronavirus have not stopped CNAO from carrying out an active programme of scientific dissemination and teaching.

Although the guided visits to the Centre have been cancelled, they offer students and teachers to participate in virtual guided tours, realized through videoconferencing platforms and a 60-minute online journey, which describes the innovative technologies available in the field of medical physics and the clinical activity performed at CNAO.

The first two guided tours took place on Friday 24 April and were a great success. 170 young people discovered the technologies supporting the activities of CNAO.

The participants can enter virtually the synchrotron bunker, an 80-meter-long particle accelerator in which protons and carbon ions travel, and marvel at the robotic patient positioning system in the CNAO treatment rooms. Physicists, engineers and technicians from CNAO accompany the participants along a 60-minute journey. The guided tours are free.

Find out more at:
https://fondazionecnao.it/visite-guidate

Designing new radiotherapy technologies to treat cancer in low and middle-income countries

STFC's Dr Deepa Angal-Kalinin will lead the accelerator design. Credit: STFC

Associated partners of OMA, STFC and the University of Lancaster are taking part in a new project to design and develop new radiotherapy technologies in Sub-Saharan Africa, giving more cancer patients access to radiotherapy, and saving lives.

Bringing together international experts in accelerator design, medical physics and oncology, alongside IT experts and health system researchers, the project will design and develop a new type of radiotherapy machine that is affordable and robust enough to be used in more challenging environments reliably, and is specifically designed to meet the needs of African hospitals.

By 2040, there will be 27.5 million new cancer cases worldwide each year, leading to more than 13 million deaths. Up to 70% of these will occur in low and middle-income countries (LMICs). However, for many LMICs in Africa there is an acute shortage of radiotherapy machines. In fact, in the lowest income countries only four percent of cancer patients that need radiotherapy treatment can access it. There are currently only 385 radiotherapy machines in the region, and 60 per cent of these are located in just three countries – South Africa, Egypt and Morocco. A recent report[1] published by the Lancet Oncology Commission estimated that by 2035 at least 5,000 additional radiotherapy machines would be needed to meet radiotherapy demands in low and middle-income African countries.

In the first phase of this innovative project, which is funded by STFC and led by the Universities of Lancaster and Oxford, the team will define the persistent shortfalls in basic infrastructure, equipment and specialist workforce, which remain barriers to effective radiotherapy delivery in Sub-Saharan Africa, and develop new solutions leading to a detailed specification and conceptual design. The project, known as ITAR (Innovative Technologies towards building Affordable and equitable global Radiotherapy capacity), will then progress to a prototype development phase of a medical linear accelerator for radiotherapy, at STFC's Daresbury Laboratory.

The University of Lancaster's Professor Graeme Burt, also of the Cockcroft Institute, is leading the first phase of the ITAR project. He said: *"Current radiotherapy machines are optimised for use in western countries. The ITAR project aims to design specifically for use in Africa making it far more tolerant to the local environment, which will greatly increase the capacity for more lives to be saved."*

STFC's Professor Deepa Angal-Kalinin, also of the Cockcroft Institute and University of Manchester, will lead the accelerator design. She said: *"I am keen to apply the knowledge and expertise at Daresbury Laboratory to develop a novel medical linear accelerator design in this phase of the project which will prepare us to build a prototype to test our new ideas."*

The ITAR project is a critical part of a larger international project that includes the International Cancer Expert Corps (ICEC), CERN, STFC (Daresbury Laboratory), and led by Lancaster and Oxford Universities. It brings together partners from the Cockcroft Institute, STFC's Accelerator Science and Technology Centre (ASTeC), the John Adams Institute, Swansea University, King's College London, National Hospital Abuja, Botswana-UPENN Partnership and Princess Marina Hospital alongside many other international partners.

Read the full Lancaster University press release for more detailed information about the ICEC project and its international partners.

[1]Global Task Force on Radiotherapy for Cancer Control (GTFRCC) of the Union for International Cancer Control (UICC) in September 2015.

Selected Publications

A mathematical expression for depth-light curves of therapeutic proton beams in a quenching scintillator
Laurent Kelleter and Simon Jolly, Med. Phys. (2020).

Experimental exploration of a mixed helium/carbon beam for online treatment monitoring in carbon ion beam therapy
Lennart Volz, Laurent Kelleter, Stephan Brons, Lucas N. Burigo, Christian Graeff, Nina Isabell Niebuhr, Raffaella Radogna, Stefan Scheloske, Christian Schömers, Simon Jolly and Joao Seco, Physics in Medicine & Biology 65(5) (2020).

Mixed ion beams could enhance particle therapy accuracy
Tami Freeman, Physics World 21 February 2020.

A scintillator-based range telescope for particle therapy
Laurent Kelleter, Raffaella Radogna, Lennart Volz, Derek Attree, Anastasia Basharina-Freshville, Joao Seco, Ruben Saakyan and Simon Jolly, Physics in Medicine & Biology (2020).

Preparation of a radiobiology beam line at the 18 MeV proton cyclotron facility at CNA
Anna Baratto-Roldán, María del Carmen Jiménez-Ramosa, Sonia Jimeno, Pablo Huertas, Javier García-López, María Isabel Gallardo, Miguel Antonio Cortés-Giraldo, José Manuel Espino, Physica Medica 74, 19–29 (2020).

Organ motion quantification and margins evaluation in carbon ion therapy of abdominal lesions
Charalampos Kalantzopoulos, Giorgia Meschini, Chiara Paganelli, Giulia Fontana, Alessandro Vai, Lorenzo Preda, Viviana Vitolo, Francesca Valvo, Guido Baroni, Physica Medica 75, 33–39 (2020).

A new treatment planning approach accounting for prompt gamma range verification and interfractional anatomical changes
Liheng Tian, Guillaume Landry, George Dedes, Marco Pinto, Florian Kamp, Claus Belka and Katia Parodi, Physics in Medicine & Biology 65, 095005 (2020).

In Vivo Validation of the BIANCA Biophysical Model: Benchmarking against Rat Spinal Cord RBE Data
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Vacancies

Open job positions at Cosylab, Slovenia

Medical Systems Engineer

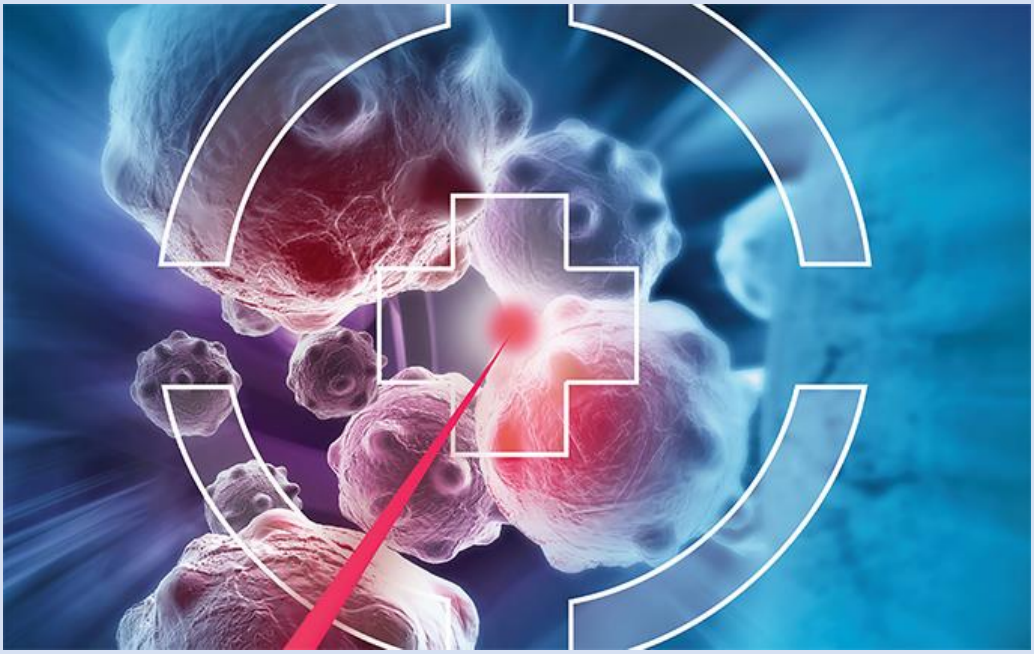
- Consult with customers, determining their needs and shape them into requirements.
- Design of safety-critical systems and involvement in the risk management process.
- Oversee the development and integration of complex software from multiple perspectives.
- Understand, co-create and apply the development processes for regulated software.
- Provide link between customer needs and production deliverables.
- Creatively solve problems during complex projects using technical a people competences.
- Understand system as a whole to assist with proper design and development approaches of effective and safe systems.
- Understand project stakeholders' issues – from developers, project managers, customers to users.

More information can be found here

Medical Physicist

- Work with medical physicists on specifications and design of software and hardware systems they are using.
- Work on developing calibration and quality assurance tools and procedures for systems for particle- and radiotherapy.
- Translate proton- and radiotherapy dosimetry and calibration standards and guidelines into new calibration and quality assurance tools and procedures.
- Work with medical physicists on integration of calibration and quality assurance tools into medical devices in radiation therapy.
- Prepare and execute installation, commissioning, verification and validation procedures for medical devices in radiation therapy.

More information can be found here



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