EFOMP

The European Federation of Organisations for Medical Physics Newsletter

European Medical Physics News

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SPECIAL ISSUE

3rd European Congress of Medical Physics Online 16th–19th June 2021

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EFOMP

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Front page photograph: View over Turin to the Alps, *by David Lurie*

EDITORIAL

Welcome to the Summer 2021 issue of European Medical Physics News, the quarterly newsletter of EFOMP! With the onset of summer, it is fantastic to see green leaves on the trees and flowers blooming once again.

The theme of this issue of the newsletter is the 3^{rd} European Congress of Medical Physics (ECMP 2020), which is taking place online from 16^{th}–19^{th} June. It promises to be a really excellent meeting, with two live streams and a total of 327 oral presentations and 358 posters due to be presented. There will be a comprehensive virtual exhibition, as well as pre-congress Schools and two Refresher Courses. The conference schedule includes plenty of opportunities to take part and to meet other participants online, since each day's programme includes regular Live Discussion sessions. The Congress and its pre-congress Schools have been accredited by EBAMP as CPD events. If you haven't yet registered for the conference, there is still time to do so by visiting the conference web site.

In this EMP News, the themed content begins with a highly informative article by ECMP President, Mika Kortesniemi. In order to help you plan your attendance at the Congress, we have included ten articles written by session Chairpersons, where they highlight the content of their sessions. As you will know, the conference was originally planned to take place in the northern Italian city of Turin. Since we cannot go there in person (this time), local medical physicist Veronica Rossetti has written an article about Turin, to whet our appetites for future visits. Veronica's article includes several photographs of this wonderful city and you will find various more views of Turin, sprinkled throughout the Summer issue.

This issue of the newsletter contains a number of regular features, including a topical message from EFOMP President, Paddy Gilligan and an overview of recent EFOMP activities by Secretary General Efi Koutsouveli. You will also find an overview of recent papers published in Physica Medica, by the journal's Editor-in-Chief Iuliana Toma-Dasu, while our popular Medical Physicist's Free Time section contains an article by Julie Haglund about her role as a fitness instructor. This issue contains two articles about medical physics research and there is a very useful resource, in the form of a comprehensive directory to help us navigate through the jungle of medical physics acronyms. Finally, our friendly Lev-the-lion cartoon character is back for another episode of his journey through diagnosis and treatment.

In a departure from our usual format, this ECMP-focussed issue is rounded off by an ECMP Commercial Supplement, with no fewer than 12 articles from commercial companies, including sponsors of the conference and those which are EFOMP Company Members. I am sure you will enjoy reading about the companies' products and activities.

As ever, this issue of European Medical Physics News contains a wealth of material and I hope you will enjoy reading it!

David Lurie is Chair of the Communications and Publications Committee of EFOMP. He holds a Chair in Biomedical Physics at the University of Aberdeen, UK, where his research group works on the technology, methods and applications of low-field MRI. Prof. Lurie was awarded the Academic Gold Medal of IPEM in 2017 and was named as a Fellow of the International Society for Magnetic Resonance in Medicine in 2021.

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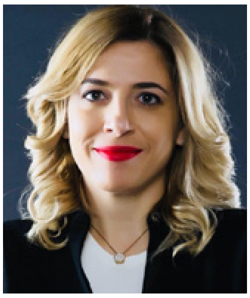

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EFOMP President's Message

EFOMP President Paddy Gilligan writes about the organisation's news and recent activities and the forthcoming ECMP conference

Summer Greetings Medical Physics Friends,
It's always a pleasure to mark the changing of the seasons with EMP news. The newsletter along with the website, social media and European Journal of Medical Physics forms part of the many excellent activities of our very busy and engaged Communications and Publications committee, under the watchful eye of David Lurie.

I want to take this opportunity to update you on EFOMP activities and recent developments as we mark the halfway point of the first year of my three-year presidency and that of the new committee chairs. We had the twin challenges of COVID and Brexit overhanging the federation coming into this year. However, it is only through such challenges that we see the real dedication, adaptability, generosity and spirit of the volunteers who contribute to EFOMP on behalf of their patients and colleagues.

We are pleased to announce that our office function has successfully moved to Utrecht in The Netherlands and our bank account is functioning again. This, with the help of Jaroslav Ptácek, Mani Mannivannan and Christos Alexakos has allowed us to register Individual Associate Members and Company members, all important elements of the EFOMP family.

EFOMP, as all of Europe, has had to deal with the devastating consequences of the COVID virus which has had major impacts on our professional and personal lives. The good news is now that thanks to dedicated scientists and health services many of us have access to vaccines. Loredana Marcu and our European matters committee published a survey [1] in the European Journal of Medical Physics showing that as most countries prioritised health care workers and that medical physicists are recognised as health care workers, vaccine uptake and availability was strong in our community.

The aim of EFOMP is to educate, integrate and communicate. One of the great benefits of EFOMP through its education programs and participation in congresses is meeting face to face, enjoying each other's company and finding out how medical physics operates in their country or hospital. We had looked forward to organising our flagship – the European Congress of Medical Physics – in person in the beautiful and welcoming city of Torino. In March we made a decision in association with local guidance to move the congress fully online. It looks that this has been very successful thanks to the wonderful efforts of Mika Kortesniemi, Marco Brambilla, Symposia and the AIFM. There have been 742 abstracts submitted: 327 accepted as oral presentations, with 358 as posters. Many hours of strong educational and scientific content will be available online. There will even be a social program with a tour of the famous Egyptian museum in Torino and a special musical evening. The advantages of the fully digital version are that the content will be available for a number of months, along with a reduced registration fee and reduced travel logistics. So please log on and register at www.ecmp2020.org. We have already begun organising the face-to-face ECMP in Dublin, Ireland, 17-20 August 2022.

The ECMP 2020 conference adds to our digital content, with over 7000 registered and 4000 attendances at 21 events including those with our collaborating organisations created on our GoTo and education platforms. These for 2021 include 2 x warm up webinars for ECMP, 1 x ESMPE schools, 6 x EUTEMPE webinars including masterclasses, 2 joint COCIR and 1 HAMP PETCT workshop. All of these have been created by the excellent volunteers, scientists and teachers who give so much of their time to make content of such a high standard. Many of us are returning to our hospital desks and coping with the build-up of postponed work during the pandemic. This will reduce attendance at live events, but a large repository of information is available on our educational platform to the 590 Individual Associate Members of EFOMP. The good news is that we are planning to expand the functionality of our educational platform to provide real opportunities for accredited learning on both NMO and federation levels. Christoph Bert and our Education and Training committee are in the process of developing the specification and vision for such a platform. Of course, greater functionality will not be possible without funding and to this end our Projects committee with Kostas Koutsogiannis are seeking opportunities under the new EURATOM funding with ENEN and under the EU cancer strategy, areas in which medical physicists play an important role.

EFOMP realises the value of accredited training and educational schemes as the best way to ensure patient safety and quality in all we do and ensure that properly trained professional physicists are carrying out medical physics tasks. The core curriculum with ESTRO is near completion and the diagnostic and nuclear medicine curricula will be focussed on toward the end of this year. The Professional Matters committee under Brenda Byrne approved a fifth National registration scheme this year and also published an important training document [2]. This is progress, but we have a long way to go with the other 31 NMOs and something that should be a priority led by our NMOs.

EFOMP recognises the importance of having an active European medical physics accreditation body, EBAMP. The federation also recognises the importance of its independence. We have agreed to provide some administrative and technical support for EBAMP without interfering with this independence.

There also has been exciting news with the strong attendance at the first Special Interest Group (SIG) organised by Manuel Bardies under the Scientific committee of Brendan McClean. This important structure will form the basis for an early career medical physicists SIG within our EU matters committee as these young physicists are the future of our profession. The seven working groups (WGs) in the Scientific and other committees have also been busy producing papers, e.g. the Artificial intelligence syllabus and the QC presentations at the European Congress of Radiology 2021. The working groups are in various stages of their cycles.

We also exist within communities of other scientists and professionals and we currently continue to work with aligned organisations through our 11 Memoranda of Understanding (MoU).

This is a relatively brief snapshot of the incredible work carried out by our EFOMP volunteers, who we are indebted to in the interests of progressing medical physics in Europe. None of this is possible without your input and I would strongly encourage all of you to put your names forward to your NMOs to contribute to our exciting activities through our committees' structures when the call comes through from our incredibly hard-working Secretary General, Efi Koutsouveli. We hope to meet some of you online through our NMOs "town hall" meeting in early July.

Beir Bua agus Beannacht (Irish language for take a victory and a blessing)!

References

[1] Marcu LG "COVID-19 vaccination rates of medical physicists throughout Europe" Physics Medica 82: 341-342 (2021) https://doi.org/10.1016/j.ejmp.2021.02.018

[2] Maas AJJ, Lammertsma AA, Agius S, Bert C, Byrne B, Caruana CJ, Gilligan P, Koutsouveli E, Pace E, Brambilla M "Education, training and registration of Medical Physics Expert across Europe" Physics Medica 85: 129-136 (2021) https://doi.org/10.1016/j.ejmp.2021.03.034

Paddy Gilligan, is President of EFOMP. He is chief physicist in the Mater Private Hospital in Dublin Ireland and has over thirty years' experience in diagnostic imaging, He has served on state boards for regulatory radiation protection agencies. He became associate professor in University College Dublin in 2017. He was the chair of the European congress of radiology physics programme in 2019. Prior to becoming President of EFOMP he chaired the successful bid for ECMP 2022 for Dublin. He is a trustee of the Robert Boyle Foundation.

ECMP 2020

The Third European Congress of Medical Physics – the Virtual Edition

ECMP President Mika Kortesniemi writes about the virtual ECMP conference, taking place on-line 16th-19th June and continuing with on-demand access until the end of year 2021

The virtual ECMP lobby created by Symposium, the secretariat of the congress

Dear Colleagues,

The Virtual ECMP makes it possible to bring the European medical physicist community together, despite the challenges brought about by the pandemic restrictions and the postponement of the originally planned Third European Congress of Medical Physics. Obviously, this was not possible without considerable adjustments and fine-tuning of the original contents. In short, this meant fitting the original three-day and four-room programme into a three-day programme with two virtual rooms, in addition to an extensive on-demand channel programme. Together, the live and on-demand contents cover the entire original ECMP programme with only a few exceptions.

As ECMP organisers, we were happy to see the dedication of European medical physicists which was shown in the final number of abstract submissions – around 750 in total. **I would like to thank each of you for sending your scientific findings into our congress. These studies are the forefront of the ECMP scientific programme**, with live and on-demand oral and e-poster presentations.

My gratitude goes also to the ECMP scientific committee and congress planning committee who made great efforts in reviewing the abstracts and making it possible to compile the final scientific programme including around 330 oral presentations and around 360 posters. The congress planning committee, local organizers and congress secretariat – Symposium – worked tirelessly to make the virtual programme into its final form.

In this final programme, the live programme is divided into two on-line broadcast rooms. Each day, on both live rooms, begins with a refresher course or special focus session followed with live discussion and a coffee break. The morning part continues with scientific sessions including keynote talks and scientific talks. Each session on each day is concluded with live discussion where chair and speakers are invited to answer the questions and respond to comments presented by the participants in the congress interactive chat during the session. Pre-recorded talks facilitate this responsive role of the presenters also during the talks. The morning part ends with joint sessions (and one scientific session) and a longer lunch break including the company symposia. Each afternoon is composed of two consecutive scientific sessions separated with live discussion and a coffee break. The second and third days end with plenary sessions comprising the medal award talk and the congress main plenary talk. The main plenary lecture will inspire us with the data-driven future of medical physics.

The on-demand programme includes an extensive collection of medical physics content in various specialities and topics. The on-demand content is distributed in ten main channels representing the three medical physicist subspecialities (radiotherapy, diagnostic and therapeutic nuclear medicine, diagnostic and interventional radiology), five major topic areas (radiation protection and dosimetry, biomedical engineering, informatics, professional issues, education and training), joint sessions with our partner organisations, and Spanish sessions representing the welcome nation of ECMP. Related to sub-specialties and informatics, the refresher courses, keynote talks, scientific talks and posters give further structure to the entire on-demand programme.

Please note that after each day of our congress, the virtual ECMP live contents are added into the ECMP on-demand materials, and this accumulated on-demand content will remain for your access throughout the year, until 31st December 2021.

The congress opening is scheduled for Wednesday, 16th June, after the pre-congress workshops of AI, nuclear medicine and radiotherapy topics. Our congress days end with a social programme which we are sure you will enjoy. As part of the ECMP social programme, we will also present the Galileo Galilei award of the year 2020.

We would also like to remind you that Physica Medica – European Journal of Medical Physics (EJMP), will publish a focus issue containing up to 50 selected papers from contributions (oral or poster) from ECMP. The papers will be selected by the guest editors and the new editor-in-chief Prof. Iuliana Toma-Dasu on the basis of the high scientific quality of the presentations. Furthermore, all abstracts accepted for ECMP will be published in a special issue of Physica Medica.

Nothing great can be done in isolation and without acknowledging the efforts made together. The same applies to the virtual edition of the Third European Congress of Medical Physics where the guiding principle has remained the same from the beginning: embracing change, sharing knowledge.

We hope that our focus to serve the European community of Medical Physics to come together in this virtual ECMP will be successful. This time it will be on-line but we already look to the future where we have the possibility to meet each other again in person. Until then, I warmly thank you for this possibility – an event which we make together.

Best summer wishes,
Mika Kortesniemi, President of ECMP 2020

Dr Mika Kortesniemi works as the Chief Physicist and Adjunct Professor in the HUS Medical Imaging Center, University of Helsinki, Finland. His professional focus is on the quality assurance, dosimetry, optimisation and radiation protection in x-ray modalities, especially the evolving CT technology. The research work is primarily related on radiological optimisation, utilizing anthropomorphic phantoms and Monte Carlo simulations. Dr Kortesniemi is the past chair of EFOMP Science Committee. In addition to his primary position in HUS Medical Imaging Center, Dr Kortesniemi is also involved in IAEA, ICRP and ESR collaboration, and quality audits in radiology.

ECMP 2020

Session summary: 17th June 09:30h, Live room "Torino"

Session chairperson, Jens Edmund, provides a preview of this session, on the topic of treatment planning, treatment delivery techniques and modelling

The digital version of ECMP 2020 is coming up soon and I will look forward to chairing a Live scientific session on treatment planning, treatment delivery techniques and modelling. The session will take place Thursday June 17th from 9:30 to 11 o'clock between the RT refresher course and the joint ESTRO session.

Photo of Turin by Archivio Città di Torino - Turismo Torino

The session will start with a keynote presentation by Ben Heijmen on potentials and limitations in automated treatment planning. I had the pleasure of co-chairing a session with Dr. Heijmen during the latest digital ESTRO congress. He has a long experience within the subject and more than 400 research publications. It will be interesting to hear his view on the latest developments within the treatment planning pillar of radiotherapy.

The session then continuous with proffered papers. Four abstracts on treatment delivery techniques will include dosimetric characterization of a FLASH radiotherapy, a novel immobilization device, radiation enhancement on breast cancer cells Incubated with gold nanoparticles, and a risk model for advanced radiotherapy techniques. The contributions on potential paradigm changing techniques such as FLASH and nanoparticle aided radiotherapy will be especially interesting to hear. The session's three remaining abstracts focus on modelling treatment outcome to identify potential predictors. They include validation of SNPs (genetic markers) for late toxicity of prostate cancer, combining CT and dose radiomics to improve prediction of lung tumour response, and, training and validating relapse-free-survival for pancreas cancer using PET radiomic. It will be a fresh feature to hear about genetic makers associated with radiotherapy as we physicists tend to focus on imaging techniques as the main source of research for response assessment. It helps remind us that cancer is a complex disease that requires the efforts from multiple scientific research areas to develop better diagnostic and treatment options. Lastly, it will be interesting to hear about the latest developments in research on image based radiomics as predictive markers for treatment outcome.

I hope you will join me and the speakers presenting these subjects on this interesting scientific session during ECMP2020!

Dr. Jens M. Edmund was chair of the ECMP 2018 local organization committee. He received his PhD in radiation dosimetry in 2007 and became a Medical Physics Expert in 2014. He works as a medical physicist at Herlev Hospital in Denmark and is adjunct associated professor at the Niels Bohr Institute.

ECMP 2020

Session summary: 17th June 14:00h, Live room “Torino”

Session chairperson, Jose Perez-Calatayud, provides an overview of the session “ECMP Welcomes Spain: Brachytherapy”

Photo of Turin by David Lurie

This session is composed of four presentations. The SEFM has decided to select the topic of Brachytherapy with a selection of topics that we think are very current as well as very active SEFM speakers in these aspects:

Antonio Herreros is an expert and researcher in the field of in vivo dosimetry in brachytherapy. Included in his presentation will be a review of the current status of this difficult subject, including the commercial equipment available as well as the promising detectors under investigation. In particular, he will delve into the use of plastic scintillation detectors and specifically their calibration.

Facundo Ballester is an experienced researcher in various areas of Brachytherapy being chair and member of several AAPM and ESTRO committees, mainly dedicated to source registry and quality assurance. His presentation will be dedicated to the new algorithms in brachytherapy. It will deal with aspects such as limitations of TG-43, impact of the new algorithms in the clinic, TG-186 recommendations, deepening on a detailed and practical commissioning to be carried out by the user of the treatment planning systems that include these advanced algorithms.

Victor Gonzalez is an expert in Brachytherapy and specifically in skin treatment, belonging to several committees of GEC-ESTRO dedicated to skin guidelines and specifically coordinating those dedicated to the use of bolus and skin brachytherapy reporting. His presentation will include the physical aspects of the ABS and GEC-ESTRO recommendations in skin brachytherapy as well as the recent AAPM-ESTRO join report TG-253 on skin applicators dosimetry and quality assurance. Finally, it will deal with the practical aspects associated with the treatment of skin large tumours.

The session chair is also an experienced medical physicist in brachytherapy, who has coordinated the SEFM group in cervix brachytherapy. His presentation, which will round off the session, will include a summary of recent SEFM recommendations in cervical brachytherapy as well as current challenges in clinical practice and promising potential future developments.

Jose Perez-Calatayud is Head of the Medical Physics Section in Radiation Therapy, Hospital La Fe, Valencia, Spain. He is a Medical Physicist dedicated to Radiotherapy., with his main focus area being Brachytherapy. He belongs to and has served on various AAPM, ESTRO, ABS and SEFM committees dedicated to producing recommendations in brachytherapy.

ECMP 2020

Session summary: 17th June 16:00h, Live room "Piemonte"

Session chairperson, Jonas Andersson, provides an overview of the science to be presented in this session, on the theme of Medical Devices, Machine Learning and Radiomics

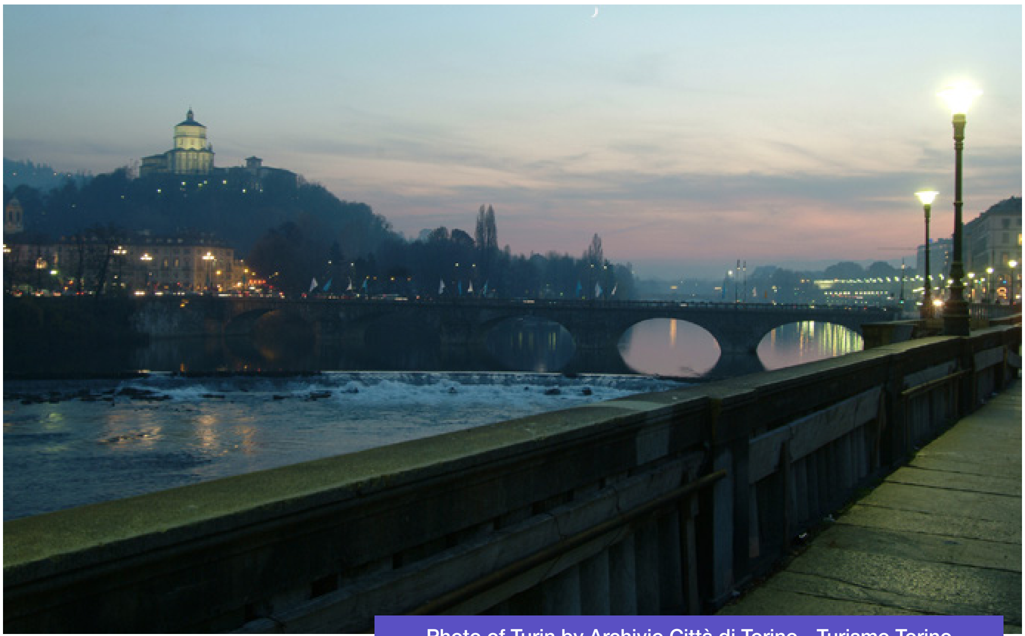
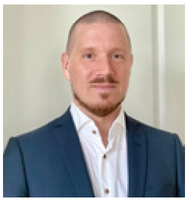


Photo of Turin by Archivio Città di Torino - Turismo Torino

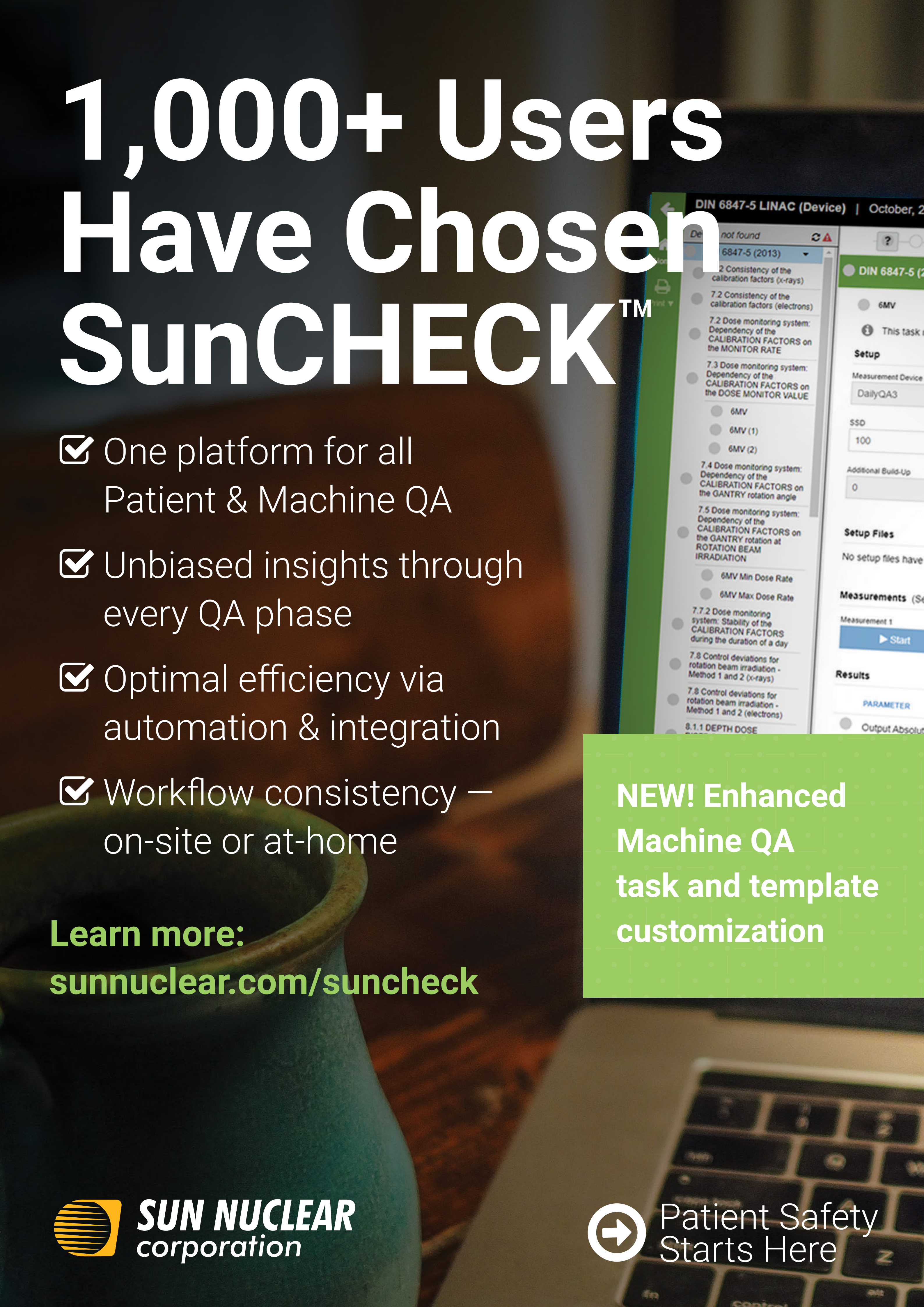
The ongoing digital transformation in healthcare has many promising aspects for improving quality of care and cost efficiency. Holistic system integration is paramount to organize information around patients rather than discrete databases. Smart devices and information technology (IT) solutions that can monitor and communicate with patients while they are outside the physical domain of healthcare are increasingly facilitated. Furthermore, new and more detailed information improving the quality of care are expected to continuously develop with radiomics (and other -omics) and artificial intelligence (AI) solutions, particularly when harvesting and analysing information from multiple sources. These changes in healthcare will increase the importance of regulatory matters on medical devices (hard- and software) and information privacy.

The fields of imaging and radiotherapy are natural stakeholders in the digital transformation given the large amounts of data generated and used in such clinical workflows, including associated quality assurance (QA) and control (QC) processes. On the clinical side, e.g., radiomics with clinical decision support systems, AI approaches including deep learning, and 3D printing, are emerging as game changers in the way healthcare is being performed and consumed.

Practitioners of medical physics can be viewed as bridging the healthcare and research perspective of the digital transformation, since we may be involved with such research initiatives, as well as in the end-user healthcare processes employing novel IT solutions and medical devices. However, perhaps the most important aspect of medical physicists' contributions in healthcare may be found in QA and QC, when such IT solutions and devices are being introduced in healthcare processes. It is thus reasonable to assume that the role of the medical physicist will also be transformed, as medical devices are becoming increasingly digital. This may allow for QC, and entire QA processes, to be automated and made continuous (real-time surveillance of key performance indicators), as opposed to samples of quality aspects performed at discrete intervals. The ongoing digital transformation of healthcare will require medical physicists to change and innovate within their practices. This will also demand new and updated initiatives within education and training of medical physicists in the years to come.



Jonas Andersson is a medical physics expert and researcher from Sweden (Region Västerbotten and Umeå University, respectively). He has a particular interest in regulatory matters on radiation safety, research in computed tomography applications, and is a co-owner of Dicom Port, which develops IT solutions for quality assurance in medical imaging.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ECMP 2020

Session summary: 18th June 11:30h, Live room "Torino"

Session chairperson, Ioannis Seimenis, provides a preview of this session, which is a joint session with ESMRMB on "Quality Control in Hybrid MR Imaging"

Photo of Turin by David Lurie

Hybrid cars are increasingly popular because of their clear advantage in fuel costs. But hybrid vehicle buyers are often surprised to discover that there are quite a few differences between a hybrid and a conventional vehicle. Similarly, the use of hybrid MRI systems is rapidly increasing due to the conspicuous benefits of hybrid technology. However, excited users of hybrid MRI systems soon realise that there are new challenges in fulfilling system quality requirements.

Quality control (QC) of multimodality systems should not only ensure the proper function of the individual components, but also the accurate and optimized performance of the combined system. Therefore, QC protocols of hybrid MRI systems should ascertain performance that clearly overrides the registration errors associated with independent operation. Spatial alignment of both components needs to be verified, whilst image co-registration has to be checked for various pulse sequences and MR techniques used clinically. MRI-based spatial distortions are relevant as they may cause errors in tissue segmentation on anatomical images, attenuation correction and treatment planning.

Comparability of imaging data and quantitative results from hybrid PET-MRI systems are often hampered by differences in QC standards, and a consensus recommendation dedicated to QC procedures for PET-MRI systems was only recently proposed. On the other hand, MRI-linacs require new aspects in reference dosimetry to be considered. MR-guided adaptive radiotherapy also requires a comprehensive end-to-end quality assurance workflow integrated in the daily clinical practice. Although phantom-based workflows have been developed and are routinely implemented, patient-centred strategies may be also needed, as in the case of patients with metallic implants within the volume of interest. Overall, QC procedures have to be tailored to the specific MRI application, with special focus on optimising synergistic outcome rather than simply testing simultaneous operation. Thus, procedural intelligence is required to refine QC operations in the hybrid MRI setting and achieve consistency across workflows with ease, regardless of procedural complexity.

In an era of hybridity, EFOMP and ESMRMB join forces to shed light on "Quality control in Hybrid MR Imaging". If you're ready to make the jump to a hybrid MRI system and you want to know what it takes to "drive in quality", join us for a session with a line-up of excellent lecturers and a live broadcast discussion on Friday 18th June 2021 at 11:30 CET. Let's gear up for high quality modality coupling!

Ioannis Seimenis is Professor of Medical Physics in the School of Medicine at the National and Kapodistrian University of Athens. Ioannis is an elected member of the Hellenic Association of Medical Physicists Board and he chairs the national committee for Radioprotection Expert certification in medical exposures.

Session summary: 18th June 14:00h, Live room "Piemonte"

Session chairperson, Kirsten Bolstad, provides an overview of this scientific session, which covers radiomics, task-based image quality metrics and clinical applications of spectral imaging and dynamic CT

Photo of Turin by David Lurie

Are you interested in learning more about radiomics, model observers, calculated detection indices and other task-based image quality metrics applied on different imaging modalities? How about clinical applications of spectral imaging? Or rejection analysis of images across multiple centres or comparing dose parameters between cone-beam CT and multi-slice CT? If one or more of these topics resonates with you, then you should join us for our scientific session on Friday June 18th at 14:00 CEST during the ECMP!

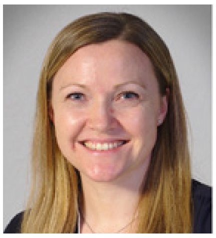
The keynote speaker of the session is the highly acclaimed Professor Nico Buls from the University Hospital in Brussels (UZ Brussel) and the University of Brussels (VUB) with his talk entitled "Clinical applications of spectral imaging and dynamic CT".

Radiomics has been demonstrated to have an increasing role in clinical processes. Stefania Pallotta will present a phantom design for testing of the reproducibility and repeatability of radiomic features extracted from CT images in the talk entitled "RadiomiK Phantom to Test the Robustness of CT Radiomic Features". Digital modalities in a radiological department makes it easy (maybe too easy?) to retake sub-optimal images. Elina Samara will present an analysis of rejected radiological images across 5 centres.

Image quality assessment of clinical protocols in CT and mammography using model observers, calculated detection index, task-based image quality metrics will also be covered in this session. David Caldwell will present "Verification of Threshold NPWE Detectability Indices with a Novel Statistical Alternative for Image Quality Assessment in Digital Mammography", followed by Anaïs Viry presenting "Assessment of Task-based Image Quality for Abdominal CT Protocols Linked with National Diagnostic Reference Levels."

Cone-beam CT and multi-slice CT has both similarities and differences. Steffen Ketelhut will present a structured review of the current literature on conversion of dose parameters between cone-beam CT and multi-slice CT.

For more information visit the updated programme on the ECMP website ECMP 2020 **and join us online for inspiring talks and live discussions!**



Kirsten Bolstad is a medical physics expert within diagnostic radiology (X-ray and CT) and the head of the X-ray physics group at Haukeland University Hospital. She has more than 15 years of experience within medical physics. Kirsten Bolstad is the newly-elected President of the Norwegian Association of Medical Physics.

ECMP 2020

Session summary: 18th June 16:00h, Live room "Torino"

Session chairperson, Bernhard Sattler, provides a preview of this session, which is on the theme of Quantitative Molecular Imaging

Nuclear Medicine Molecular Imaging traditionally has been employed to assess physiology and/or pathophysiology in diagnostic and therapeutic scenarios. Several levels of quantitative analysis are employed spanning from simple relative/visual analysis over semi quantitative to fully quantitative methods. Depending on the physical, biological and (radio-) chemical properties of a particular diagnostic or therapeutic radiotracer as well as on the protocol of administering it to the subject and the mode of imaging (static or dynamic) these methods become feasible. This session focusses on predictive incorporation dosimetry for radionuclide therapy as well as on verification of the absorbed dose in therapeutic target tissues and organs at risk (OAR) employing quantitative molecular imaging methods to quantify the temporal course of activity concentrations in tumour and healthy tissue.

Most of the RNT modalities have quantitative SPECT integrated in the workup of dosimetry. The session will, thus, be opened by a keynote presentation on the basics, methods and state of the art of quantitative SPECT by an esteemed expert in the field: Professor Brian Hutton from the University College London, UK will share his decade spanning experience in developing quantitative SPECT including development of respective imaging equipment to the state of the art as available and applied today. This will include data acquisition protocols and techniques as well as several necessary calibrations, quality assurance precautions and finally tomographic data reconstruction methodology for quantitative SPECT to serve radionuclide therapy dosimetry.

The scientific contributions to the session mainly deal with personalizing and verifying the individual dose to tumours and OAR for a wide spectrum of RNTs such as Lu177- and Ac225-PSMA therapy in castration resistant prostate carcinoma as well as the Lu177-DOTATATE in neuro endocrine tumours. Very interestingly, directly radiobiology linked topics such as correlating the absorbed dose in tissue samples with DNA damages such as double strand breaks

Photo of Turin by David Lurie

will be presented. Moreover, also PET quantification is an important topic in that session. The practice of quality assurance and standardization of quantitative hybrid PET is addressed in an EFOMP initiated European survey showing responses from 24 different countries. Along with and in comparison to SPECT/CT, the application of PET/CT for imaging Y90-labeled Radionuclides is shown in a phantom study revealing the expected results that – despite the low branching ratio – PET reveals better image quality and quantification if state-of-the-art PET/CT systems are used. The session is closed by a classic in the field: dosimetry of Radioiodine therapy showing the benefit of personalized dosimetry for this RNT modality also. Overall, there is a clear sign of the – meanwhile required by regulation in most of the European countries – necessity of personalizing and individualizing the treatment-planning, observing and -verification nuclear medicine modality of radiation treatment, RNT, to optimize the outcome of it while minimizing side effects and damage to healthy tissue. One, if not the most important tool to achieve this is quantitative hybrid molecular imaging such as SPECT and PET, meanwhile enabling really quantitative approaches truly theranostic workups.

This session is internationally populated by scientists from all over Europe, with one contribution from North America; it is sure to be of great interest to all in the field!

Bernhard Sattler is head of the medical physics and data analysis section of the Dept. of Nuclear Medicine of the University Hospital Leipzig, Germany, and honorary professor for medical engineering at the University of Applied Sciences Mittweida, Germany. His research interests are in hybrid molecular imaging and in clinical and radiation protection internal dosimetry; he belongs to the early adopters of PET/MRI in research and clinical settings. For more than a decade, he has been involved in the physical and technical support of the implementation of hybrid cross-modality molecular imaging techniques in interdisciplinary clinical routine and research workflows.

ECMP 2020

Session summary: 18th June 16:00h, Live room "Piemonte"

Session chairperson, Daniela Thorwarth, provides a preview of this session, which covers Monte Carlo methods in medical physics

Photo of Turin by David Lurie

During the virtual edition of this year's European Congress of Medical Physics (ECMP), a scientific session on various applications of Monte Carlo methods for research purposes in Medical Physics will take place in one of the live channels on Friday, June 18th, 2021.

This session will start with a keynote lecture on unusual applications of Monte Carlo held by Antonio Lollena, Spain. Furthermore, the session will contain six proffered paper presentations. A first talk will discuss results of a Monte Carlo project aiming to generate heterogeneous phantoms for breast mammography. The following presentations focus on the use of Monte Carlo to simulate realistic SPECT patient images for ^{177}Lu dosimetry and to perform precise dose calculations in nuclear medicine. Another project investigates the use of Monte Carlo simulations for proton radiotherapy dose calculations. The two final talks will be discussing the use of Monte Carlo simulations for estimating radiation dose of Mammography and CT examinations.

With this impressive list of different applications, this ECMP session will show the wide spectrum of Monte Carlo simulations in today's Medical Physics research.

Daniela Thorwarth is head of the Biomedical Physics research section at the University Hospital of Radiation Oncology in Tübingen, Germany. Her research interests are the integration of functional and quantitative imaging into personalized radiotherapy planning and delivery with a special focus on MR-guided radiotherapy. Daniela is an active member of the ESTRO physics committee.

ECMP 2020

Session summary: 19th June 09:30h, Live room "Piemonte"

Session chairperson, Carmel Caruana, provides a preview of this session, which covers Professional Matters, Education and Training

This session is particularly relevant to those medical physicists who are in or aspire to be in leadership positions in the role development, education and training and registration of medical physics professionals and would like to see where the profession is heading in these matters. The session touches on a wide spectrum of topics ranging from the education and training of MPEs to new highly successful innovative experiments in attracting young students to the profession to how we are going to push our role with regard to radiomics and AI in our areas of specialisation. A very varied session indeed!

The session starts with a keynote presentation by Ad Maas, immediate past-Chairperson of EFOMP's Professional Matters committee, who will describe the results of a just-off-the-press survey on the Education, Training and Registration of MPEs in Europe. You can download the full survey results freely from Physica Medica. Alberto Torresin will then describe to us the ongoing successes of the EFOMP School for Medical Physics Experts. Cristina Garibaldi will talk about present work towards an update of the ESTRO-EFOMP Core Curriculum. Yassine Bouchareb will then help us get to grips with the relevant topic on how we are going to help in translating radiomics and Artificial Intelligence to the clinical practice in all three specialty areas of medical physics. Giorgia Loreti will tell us how we may use the IAEA Human Health Campus and E-learning Platform to develop our knowledge and skills. Carmel Caruana will describe how he has solved on a permanent basis the problem of low numbers of medical physicists and indeed physicists through an innovative combined 'Physics, Medical Physics and Radiation Protection' undergraduate degree which has attracted record numbers of new students to the profession and physics. Jim Malone will share with us his overarching, comprehensive experience on the development of all aspects of Medical Radiation Protection with a particular emphasis on ethical and governance aspects. Finally, Esther van Schrojenstein Lantman will tell us how we can customise radiation protection education and training to the different learning needs and professional perspectives of the different categories of healthcare professionals.

Photo of Turin by David Lurie

Professor Carmel Caruana from Malta has authored over sixty papers concerning professional and E&T issues including the European Guidelines on the MPE and EFOMP policy statements. He set up the EFOMP School for MPEs and the EUTEMPE module on leadership. His book on professional leadership in medical physics has recently been published (https://iopscience.iop.org/book/978-0-7503-1395-7).

ECMP 2020

Session summary: 19th June 16:00h, Live room "Piemonte"

Session chairperson, Alejandro Mazal, provides a preview of this scientific session, focussing on innovations in radiation therapy

In one of the last scientific sessions of the ECMP (19th June, 16:00h), five colleagues present their works and vision on subjects that concentrates some of the key "present and future" medical physics issues in radiation therapy: accuracy in photon and proton calculations, radiomics and nanoparticles, and clinical applications as massive as breast tumours or in a selected "niche" such as total body irradiations.

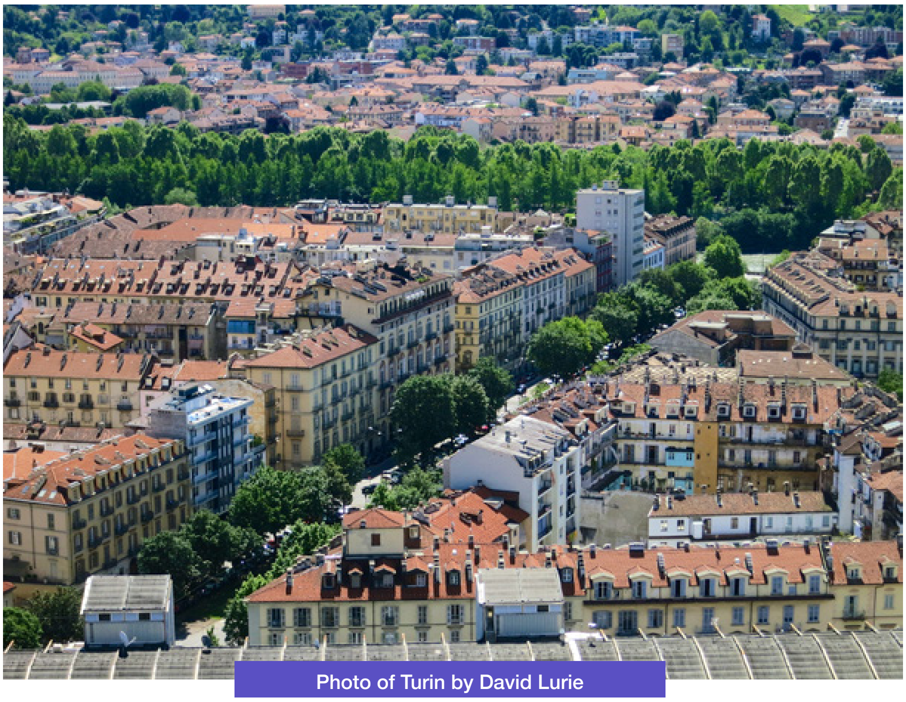


Photo of Turin by David Lurie

Dr Francesc Salvat, from the Universitat de Barcelona, Spain, has a keynote presentation on the PENH extension for proton transport in PENELOPE, revealing the influence of nuclear interactions on proton transport processes and on the calculation of dose distributions from proton beams, one of the most used and promising methods to reduce uncertainties in proton therapy planning. Dr Yibao Zhang, from the Peking University Cancer Hospital & Institute, presents the patient-specific analysis based on kV-CBCT used for image-guided radiotherapy using temporal radiomics tracking following previous works of the group e.g., in predicting radiation-induced pneumonitis from radiomics features in CBCT. Dr Emilia Esposito, from Humanitas University in Milan, Italy, evaluates the impact of commissioning measurements accuracy on the configurations of Acuros-XB and AAA dose calculation algorithms for photon beams, also in continuity with the approach of the group using reference data, representative data, different detectors and simulating measuring errors on the final configuration of the system. Dr Antonio Leal, from the University of Sevilla, Spain, presents his work on gold nanoparticles and Stereotactic Ablative Body Radiation (SABR) for treatment planning of intact breast tumour, in the promising research field of gold nanoparticles in radiation therapy, both as an imaging tool and as a sensitizer even with MV beams. Finally, Dr Elena Villaggi, from the Azienda Unita Sanitaria Locale, Piacenza, Italy, presents a forward planning approach for a single-isocenter ARC Total Body Irradiation (TBI), providing a simple and fast method compared to anterior-posterior and multiple-isocenters approaches. This promises to be a fascinating session!

Dr Alejandro Mazal, engineer, medical physicist, PhD (Buenos Aires, Toulouse, Paris), sabbaticals in Boston (MGH) and Indiana (IU), in proton therapy since 1990, past-chairman of PTCOG, head of medical physics at Institut Curie in Paris from 2008 to 2019, present director of physics at the first proton therapy center in Spain, Quironsalud in Madrid.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ECMP 2020

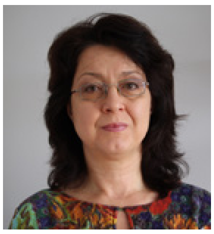
Session summary: 19th June 16:00h, Live room "Torino"

Session chairperson, Simona Avramova-Cholakova, provides a summary of this scientific session, which covers diagnostic and interventional radiology

The scientific session, dedicated to Diagnostic and interventional Radiology on Saturday afternoon, will include an informative keynote talk presented by Dr Gisella Gennaro, medical physicist at the Breast Imaging Unit of Veneto Institute of Oncology, Padua, Italy. The talk will be dedicated to the New Technologies for Mammography Imaging. Technologies which are already partially clinically used will be considered. Those will include digital breast tomosynthesis and the debate about its usage, especially in mammography screening, contrast-enhanced mammography, and the additional roles it is gaining in clinical practice. Also, software tools for image analysis will be discussed, like those used for breast density evaluation, which could be useful in risk assessment models, and more recent radiomics applications and new CAD technologies, based on artificial intelligence.

Photo of Turin by David Lurie

Additional interesting talks during the session will focus on novel developments like Patient-derived 3D Printed Breast Phantoms for Mammography and Digital Breast Tomosynthesis (presented by Antonio Varallo), Preliminary Evaluation of a Novel Deep Learning Image Reconstruction (DLIR) Algorithm in Computed Tomography (presented by Paolo De Marco), Human Brain Folding Features for Dementia Prediction (presented by Salvatore Magri), and Applying a Machine Learning-based Approach to Predict Distant-relapse-free Survival in Upfront Resectable Pancreatic Adenocarcinoma Based on CT Radiomics (presented by Martina Mori). We are looking forward to your participation in this exciting session.



Dr Simona Avramova, is a medical physicist with more than 25 years of experience, currently working at Imperial College Healthcare NHS Trust, London. She is former President of the Bulgarian Society of Biomedical Physics and Engineering and former member of EFOMP Examination Board. She has extensive teaching experience and participated in many IAEA missions.

ECMP 2020

Highlights of the city of Torino

Were it not for the pandemic, the 3rd European Congress of Medical Physics would have taken place in the fabulous city of Torino (Turin) in Italy's Piedmont region. In this article, Medical Physicist and Torino resident Veronica Rossetti takes us on a historical and geographical tour of the city.

Torino landscape from Superga hill (photo by V. Rossetti)

Like all great European capitals, Torino was born from the stratification of cultures, peoples and civilisations. The city is scattered with testimonies of the past, telling a story that began more than two thousand years ago: the oldest documents describe a small village nearby the Alps called Taurasia, a settlement, populated by the "taurine" tribes, descending from the union of Gauls and Celtic Ligurians, that was destroyed by Hannibal in 218 BC. In Roman Age it became a military citadel that under Augustus, in 28 B.C., took the name of **Augusta Taurinorum**. It was a settlement with a chessboard plan, built on parallel and perpendicular streets, which is still clearly visible today. The most important roman remains consist of the ruins of the walls near the **Porta Palatina** (or Porta Palazzo - the square in front of which is now one of the largest open-air markets in Europe) and the **theatre**, flanked by sections of the foundations of its structures.

Piazza San Carlo (photo by R. Bussio)

In 1280 the Savoy dynasty conquered Torino. Under their reign, the city underwent one of the most important transformations in its history. In 1563, the Savoy moved their capital here from Chambéry and brought in the best architects of the time: Ascanio Vitozzi, Amedeo and Carlo di Castellamonte, Guarino Guarini and Filippo Juvarra. Thanks to their flair and creative genius, the city became one of the major capitals of the Baroque. The Baroque age gave the city jewels of great splendour, such as the **Chapel of the Holy Shroud** - a Baroque masterpiece by Guarino Guarini - the church of San Lorenzo, and the **Sanctuary of the Consolata**. Baroque also identifies the style of some of the most famous streets and squares in the historic centre, including **Via Po, Piazza Castello and Piazza San Carlo**. The heart of Torino's Baroque system, however, is the "**Corona delle Delizie**" (Crown of Delights): a circuit of 15 Royal Residences - urban, suburban and located in the rest of Piedmont - declared a "**World Heritage Site**" in 1997. In town, we would like to mention: the Royal Palace, the residence of the Savoy family until 1865, **Palazzo Madama**, which houses the Museum of Ancient Art, and **Palazzo Carignano**, seat of the Subalpine Parliament and the first Italian Parliament after National Unity (which can be visited today). Outside the city: the **Palazzina di Caccia di Stupinigi** (a Royal Hunting residence), the **Reggia di Venaria Reale** (Royal Palace of Venaria, completely restored shows its ancient splendour even in the gardens) and the **Castello di Rivoli** (which houses the Museum of Contemporary Art). This castle, designed by Juvarra in 1700 following the example of Versailles, is connected along a 20 km axis to the **Basilica of Superga**, also by Juvarra, which dominates the city from the homonymous hill. The Basilica was built following the vow made to the Virgin Mary by Duke Vittorio Amedeo II of Savoy in 1706, during the siege of Torino by the French. The Duke climbed the hill to see the enemy troops from above and promised to build a great church dedicated to Her if the Piedmontese managed to drive out the enemy.

Palazzina di Caccia di Stupinigi (photo by R. Bussio)

Torino has acquired a particular style, charm and elegance that have been one of its distinctive features for centuries. An economic, production and trade centre, the first manufacturing industries were born here and in particular the **art of chocolate making** developed, the pride of Torino's tradition in Italy and the world. The great chocolate makers include Peyrano (Corso Moncalieri) and Guido Gobino (Via Lagrange). A very Torinoese habit is to have a **hot chocolate cup** or a "**bicerin**" ("small glass" in Torinoese dialect, with coffee, hot chocolate, rum and cream) in one of the magnificent cafés in the city centre, such as **Baratti & Milano** or **Mulassano** in Piazza Castello, or at **Caffé il Bicerin** in Piazza della Consolata, already praised by Alexander Dumas and visited by all the celebrities passing through the city.

Torino also became important from a religious point of view, particularly from 1578, the year in which Duke Emanuele Filiberto definitively transferred the **Holy Shroud** from Chambéry: the sheet that, according to tradition, wrapped the body of Jesus Christ, is still nowadays housed in the purpose-built Chapel. Torino is also a cultural centre full of ferment. The **University**, founded in 1404, attracted minds from all over Europe: one of the geniuses of Renaissance humanism, **Erasmus of Rotterdam**, graduated here. Torino is also the place loved by Montesquieu and the French politician and intellectual **Charles de Brosses** called it "the most gracious city in Italy and, for I believe, in Europe". **Friedrich Nietzsche** also loved the city and lived there for a while. Here he wrote The Antichrist, The Twilight of the Idols and Ecce Homo.

Pallazo Reale (photo by R. Bussio)

The rule of the Savoy family was interrupted in 1798, when Napoleon's troops occupied the city, Piedmont was annexed to France and Torino saw its defensive walls fall and it was transformed from a citadel into a spacious city, with large tree-lined avenues in the Parisian style. The Congress of Vienna in 1814 returned Torino to the Savoy family, and it was with the accession to the throne of Vittorio Emanuele II and the work of Camillo Benso Conte di Cavour that the city became a protagonist of national history, guiding the process that would lead to the Unity of Italy. In 1861 Torino was the **first capital** of the **Kingdom of Italy**.

Having lost its role as national political centre in 1865 when the capital of the Kingdom of Italy was moved to Florence, Torino chose a new vocation, industry. A special commission studied how to transform the Savoy city into an industrial metropolis on the English model. The initiative was successful and in a few years, ministries and embassies gave way to workshops and factories, and the city increasingly defined the industrial component of its identity. This process culminated in 1899 with the founding of **FIAT - Fabbrica Italiana Automobili Torino**. The factory was to become a symbol of the city for a long time, sharing its success with another historic brand of Torino's automobile industry: **Lancia**.

Torino is also the home of fervent cultural activity. **Luigi Einaudi** taught here, **Antonio Gramsci** and **Piero Gobetti** studied here, writers such as **Cesare Pavese** and **Primo Levi** grew up here, along with musicologist Massimo Mila and philosopher Norberto Bobbio. **Giulio Einaudi**, founder of the publishing house of the same name, was also part of the group: one of the points of reference for Italian anti-fascist culture.

It was in Torino that Italian **cinema** was born and developed. In 1914, director Giovanni Pastrone shot "Cabiria", from a subject by Gabriele D'Annunzio: it was to be the first full-length film to be distributed worldwide. Today you can visit the amazing **Museum of Cinema** inside the **Mole Antonelliana**, the city's symbolic monument.

Mole Antonelliana (photo by R. Bussio)

The history of the radio, and later of television, also starts in Torino, where in 1929 the EIAR, Ente Italiano per le Audizioni Radiofoniche, the ancestor of Rai, RadioTelevisione Italiana, had its first headquarters.

Vermouth, a wine-based alcoholic drink to be enjoyed before dinner, with a slightly bitter and herbaceous flavour, was also invented in Torino. The aperitif was born, a custom now exported everywhere, and for which **Martini & Rossi** is a globally recognised Torinoese brand. The same goes for **Lavazza**, one of Italy's leading coffee brands.

Po river and Valentino castle (photo by R. Bussio)

In 2006 Torino, surrounded by the nearby Alps, hosted the **Winter Olympic Games**, which gave it worldwide visibility and helped to put the town on the tourist circuit.

In conclusion, Torino, with the river Po dividing the "city" from its hills, is truly a magical place to be discovered... the ECMP 2020 Congress will be online, but the city awaits you in person, and I am sure it will not disappoint.

Veronica Rossetti, is an Italian medical physicist working in Turin, Italy, in the medical physics department of the University Hospital Città della Salute e della Scienza. Her professional focus is diagnostic radiology imaging and dosimetry, but she is also involved in educational programmes for medical physicists and other health professionals. She is a member of the scientific committee of the Italian Association of Medical Physics (AIFM) and of the Communication and Publication Committee of EFOMP.

EFOMP Secretary General's report (March – May 2021)

In this article you will find an update on the institutional matters of our organization during the last three months

EFOMP Spring Officers Meeting

This year the EFOMP governing committee met online on the 14th and 15th of May 2021. Exceptional work has been done during the first 4 months of the year by all committee members and this has been presented by the committee chairs. National Member Organisation boards will be updated on professional, educational and scientific matters, projects and activities via an online event in early July.

During the meeting it has been confirmed that the next council meeting will take place in Kaunas, Lithuania in conjuction with the 15th International Conference "Medical Physics in Baltic States 2021", organized by the Kaunas University of Technology (Lithuania), the Lithuanian Society of Medical Physicists and the Malmö University Hospital, Lund University (Sweden).

The EFOMP school will run an in person edition jointly organized with EURADOS and IRPA on "Individual dosimetry in medical applications", on the day before the conference.

Online meeting of the EFOMP Governing Committee in May 2021

EFOMP Committees, new committee members and roles

We welcome Irene Hernandez Giron (ES) as secretary of the Science committee and Marion Essers (NL) as secretary of the Education and Training committee.

Newly appointed committee secretaries. Marion Essers on the left and Irene Hernandez Giron on the right.

NMOs Presidents and delegates can nominate colleagues interested to join EFOMP committees by sending a nomination email to: secretary@efomp.org

EFOMP representatives

Congratulations to:

- Erato Stylianou Markidou (CY), for being appointed as Chair of EURAMED Communications committee.
- Marta Sans Merce (SW) appointed as member of the European Society of Radiology (ESR) Audit and Standards Subcommittee by the ESR Executive Council.
- Osvaldo Rampado (IT) as chairperson of the "Physics in Medical Imaging" scientific subcommittee, European Congress of Radiology 2023 (ECR 2023). Eight Medical Physicists will be nominated as subcommittee members/reviewers taking into account the terms of office, geographical distribution and subspecialties of members.
- Mika Kortesniemi (FI) as EFOMP representative in the ECR 2023 Postgraduate Educational Programme Subcommittee.

EFOMP Publications

EFOMP working groups and committee members published the results of surveys on education and training of Medical Physicists as well as the outcome of the Working

Group on Artificial Intelligence in the European Journal of Medical Physics.

- Focus issue: Artificial intelligence in medical physics. Volume 83, March 2021, Pages 287-291.
  https://doi.org/10.1016/j.ejmp.2021.05.008

- EFOMP survey results on national radiotherapy dosimetry audits. Volume 84, April 2021, Pages 10-14.
  https://doi.org/10.1016/j.ejmp.2021.03.020

- Towards an updated ESTRO-EFOMP core curriculum for education and training of medical physics experts in radiotherapy – A survey of current education and training practice in Europe. Volume 84, April 2021, Pages 65.
  https://doi.org/10.1016/j.ejmp.2021.03.030

- Education, training and registration of Medical Physics Experts across Europe. Volume 85, May 2021, Pages 129-136. https://doi.org/10.1016/j.ejmp.2021.03.034

- A generic curriculum development model for the biomedical physics component of the educational and training programmes of the non-physics healthcare professions. Volume 85, May 2021, Pages 32-41.
  https://doi.org/10.1016/j.ejmp.2021.04.015

- EFOMP has contributed by writing a chapter in "Medical Physics during the COVID-19 Pandemic Global Perspectives in Clinical Practice, Education and Research", the European perspective.
  https://doi.org/10.1201/9781003144380-10

Collaboration with Affiliated organizations

EFOMP is the newest member of the European Nuclear Education Network (ENEN). EFOMP joined ENEN in March 2021. The online General Assembly and Social event was attended by President Paddy Gilligan, SG Efi Koutsouveli, chair of Projects committee Konstantinos Koutsogiannis and members of Projects committee. EFOMP committee members will contribute to the ENEN Summer School for BSc and MSc students as lecturers and to the PhD Event & Prize competition as juries. The PhD event is organized to promote and support the work of young researchers in Europe. Thanks to Sam Agius (MT), Assen Dimov (BG), Carmel Caruana (MT), Marion Essers (NL), Gillian Power (IE), Joao Seco (DE), Niklas Wahl (DE) for representing EFOMP.

EFOMP participated in the EFRS Radiographer Education, Research, and Practice Summit on 14th May. A short presentation was given by President Paddy Gilligan. Adriaan Lammertsma, past chair of Education and Training committee participated in the panel discussion at the end of the event on the future role of the radiographer profession in medical imaging, nuclear medicine, and radiotherapy services.
A joint EFRS-EFOMP webinar will be planned on the principles of daily, monthly and annual machine QA on radiotherapy equipment in June. Medical Physicists, Laura Shields (IE) and Angelo Monti (IT) will deliver the lectures.

EFOMP participated as a stakeholder organisation in the International Atomic Energy Agency (IAEA) Technical Meeting on Developing Effective Methods for Radiation Protection Education and Training of Health Professionals. An EFOMP team including Loredana Marcu (RO), Christoph Bert (DE) and Brenda Byrne (IE) spoke across a range of topics in the IAEA meeting which was attended by over 200 participants from 65 countries and 23 international organizations. The purpose of the event was to exchange experiences and provide advice on developing effective methods and innovative approaches for education, training and professional development of health professionals, with a view to ensuring that they meet the requirements for qualification and competence in radiation protection and safety in medical uses of ionising radiation.

EFOMP organized joint scientific sessions during the EANM2021 "Harmonisation and Standardisation in Nuclear Medicine" in October and ESTRO2021 "New radiotherapy technology - What does it mean for radioprotection" in August.

Members from AAPM's Data sciences committee met with EFOMP President, SG and chair of the Artificial Intelligence Working group to identify possible synergies and mutual interests and efforts on this topic.

Finally, an MoU has been signed between EFOMP and the European Organisation for Research and Treatment of Cancer (EORTC). The areas of collaboration between the two societies include educational activities and scientific collaboration in research activities to facilitate technology-oriented trials. EORTC will call upon EFOMP for medical physicists willing to collaborate in clinical trials necessitating and missing a strong imaging, nuclear medicine or radiotherapy physics expert.

I am closing this update with emails I received from attendees of the EFOMP joint webinars (with EUTEMPE and COCIR) which took place during the COVID19 pandemic period and by sending my deepest thanks to all colleagues who contributed to their success!

"I just wanted to say thank you so much for today's webinar it was very interesting and so helpful. I have just moved to working in Medical Physics in a hospital from another radiation related industry so am slowly building my knowledge with the hope of one day producing a Radiation Protection Advisor portfolio. This topic was incredibly useful, any other talks on radiation safety topics like area monitoring or room design would be great if you get the chance in the future.

I will definitely be joining in for your next talk. Thank you again for your time. Best webinar I've sat in in ages!"

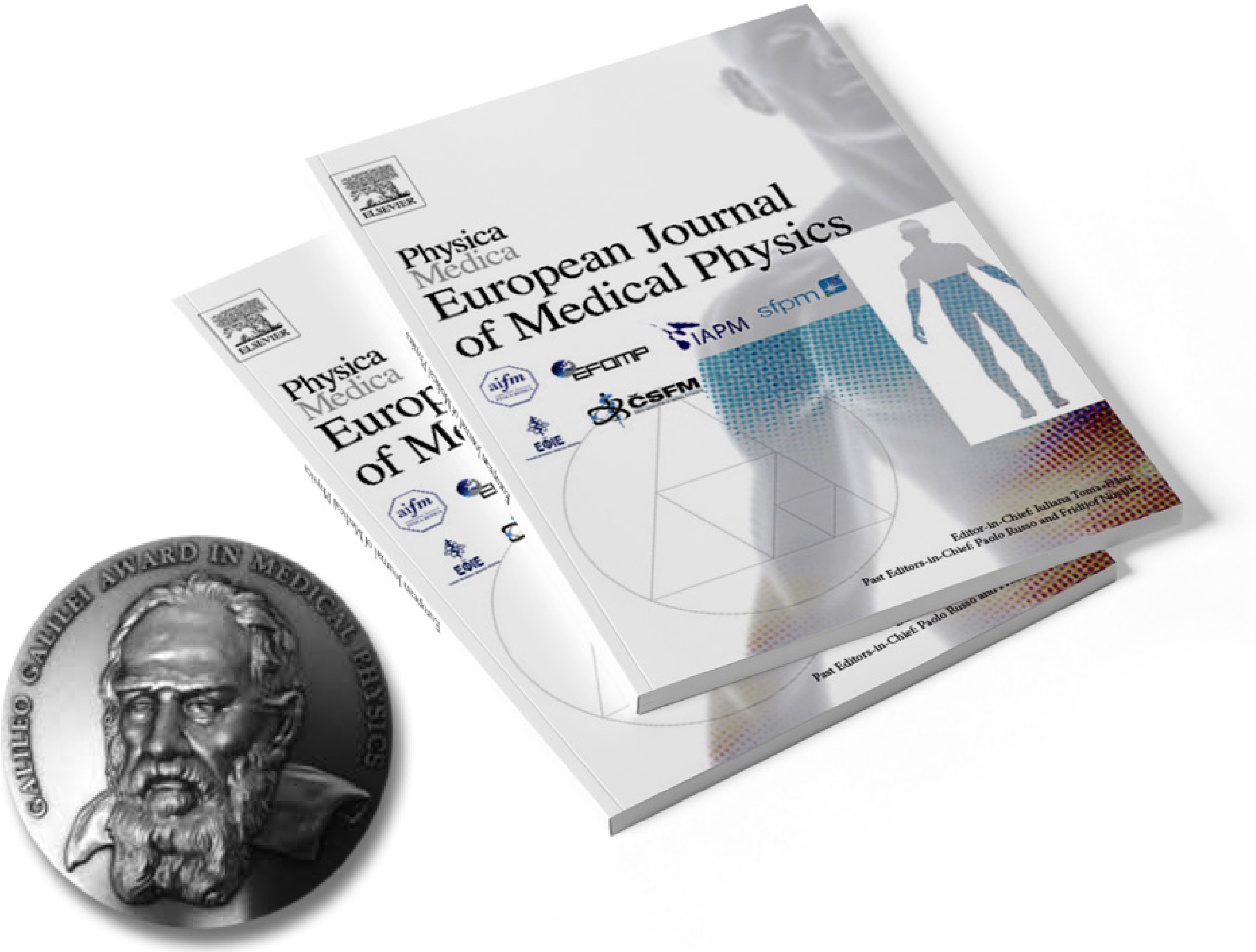
"Thanks for producing and making available quality materials! Thanks also for engaging the community with these online webinars and continuing the work of EFOMP with creative and online formats. I am particularly glad that EFOMP has not resigned to 'we can't do our work' because of changed situations regarding travel possibilities and personal engagements."

"The webinar was very special and I really enjoyed it. Congratulations on such a great program you run there. Delighted to participate".

Efi Koutsouveli is a Medical Physics Expert at Hygeia Hospital, Athens, Greece. She is Secretary General of EFOMP.
Email: secretary@efomp.org

EJMP ANNOUNCEMENT

Physica Medica: Announcement of Galileo Galilei Award



Physica Medica – the European Journal of Medical Physics is happy to announce that the paper **"Technical challenges for FLASH proton therapy"** by Simon Jolly, Hywel Owen, Marco Schippers, Carsten Welsch, published in Physica Medica, Volume 78, October 2020, Pages 71-82, https://www.physicamedica.com/article/S1120-1797(20)30196-4/fulltext, has been elected the best paper published in the journal in the year 2020.

In this paper the authors performed a comprehensive and systematic study and analysis of the technical challenges posed by the accelerator technology in order to be able to deliver FLASH proton therapy. Particular attention was given to FLASH proton delivery methods concluding that the hybrid approaches employing a combination of the scattering and scanning methods, particularly the use of scanned beams with patient-specific range modulators, are likely to be the method of choice for clinical proton FLASH delivery. Their work can be regarded as one of the major steps towards the clinical implementation of the FLASH treatments using protons.

The Galileo Galilei Award, consisting of a medal and a certificate, will be presented to the authors during the 3rd European Congress of Medical Physics (ECMP 2020), taking place online 16th-19th June 2021

Prof. Iuliana Toma-Dasu
Physica Medica Editor-in-Chief

Physica Medica: Editor’s Choice

In this regular feature, Prof. Iuliana Toma-Dasu, Editor-in-Chief of Physica Medica – European Journal of Medical Physics, gives her choice of recently-published articles

For this summer issue of EMP News I selected the following four articles, recently published in Physica Medica (EJMP), which particularly attracted my attention.

G. Kayal et al. **Generation of clinical ^{177}Lu SPECT/CT images based on Monte Carlo simulation with GATE** Phys. Med. 2021; 85: 24-31 https://www.physicamedica.com/article/S1120-1797(21)00158-7/fulltext

This paper drew my attention because it aims at taking us closer to evaluating the uncertainties associated with each step of the clinical dosimetry workflow through a virtual multicentric clinical trial. In the era of large common projects involving many centres, a reliable and comprehensive frame for evaluating dosimetric uncertainties is very important. The work presented in this paper is part of the larger project called DosiTest that aims at addressing the issue of dosimetric uncertainties in molecular radiotherapy. The overall aim of this project is to create a ‘virtual’ multicentric clinical dosimetry trial. The findings of this work will be further tested within the IAEA Dosimetry in Molecular Radiotherapy for Personalized Patient Treatments CRP project E23005.

M. Mori et al. **Robust prediction of mortality of COVID-19 patients based on quantitative, operator-independent, lung CT densitometry** Phys. Med. 2021; 85: 63-71 https://www.physicamedica.com/article/S1120-1797(21)00179-4/fulltext

There is no need to explain why the training and the validation of a predictive model of mortality for hospitalized COVID-19 patients based on lung densitometry as the one presented in this paper is of key importance in the current context of the COVID-19 pandemic. The authors of this work showed us that a rather low number of CT-based quantitative features extracted with an operator-independent approach based on lung densitometry of COVID-19 patients can be combined to build a model for the risk of death. The model had moderately to high discrimination power in classifying patients according to the risk of death and it has the potential to be significantly improved if the densitometry-based features are combined with clinical, patient specific, features.

E. Mastella et al. **High-dose hypofractionated pencil beam scanning carbon ion radiotherapy for lung tumors: Dosimetric impact of different spot sizes and robustness to interfractional uncertainties** Phys. Med. 2021; 85: 79-86 https://www.physicamedica.com/article/S1120-1797(21)00185-X/fulltext

Motion management is one of the key issues in the treatment of lung tumours with all radiation modalities and therefore various strategies are currently employed. This study presents the first investigation of the potential of gated four-dimensional restricted robust optimization for hypofractionated carbon ion radiotherapy of lung tumours. The results are very encouraging proving that gated four-dimensional restricted robust optimization was highly robust against setup and motion uncertainties with respect to both target coverage and normal tissue sparring. Given the novelty of the study and the clinical relevance, these results are of high interest for all other carbon ion radiotherapy clinics operating around the world.

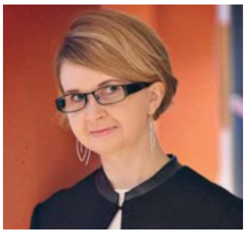
R. Lorentsson et al. **Evaluation of an automatic method for detection of defects in linear and curvilinear ultrasound transducers** Phys. Med. 2021; 84: 33-40 https://www.physicamedica.com/article/S1120-1797(21)00142-3/fulltext

This paper was selected because it has a very clear clinical application. The authors present the evaluation of a novel automatic method used for early detection of transducer defects. The method was previously developed by the same group and it employs the use of stored images only for the automatic detection of defective transducers. The noticeable advantages of the method tested in this study are to remotely monitor simultaneously many transducers and send notifications when a defective transducer is found, in addition to be interference-free with the clinical examinations.

In addition to the above mentioned studies, I would like to mention two more papers recently published in our journal related to the activities of EFOMP and hence of high importance for our professional community:

O. Casares-Magaz et al. **EFOMP survey results on national radiotherapy dosimetry audits** Phys. Med. 2021; 84: 10-14 https://www.physicamedica.com/article/S1120-1797(21)00136-8/fulltext

C. Garibaldi et al. **Towards an updated ESTRO-EFOMP core curriculum for education and training of medical physics experts in radiotherapy – A survey of current education and training practice in Europe** Phys. Med. 2021; 84: 65-71 https://www.physicamedica.com/article/S1120-1797(21)00147-2/fulltext



Iuliana Toma-Dasu,
Editor-in-Chief of Physica Medica – European Journal of Medical Physics

UPCOMING CONFERENCE

Upcoming EANM '21 Congress - Joint Symposium between EFOMP and EANM on Harmonisation and Standardisation

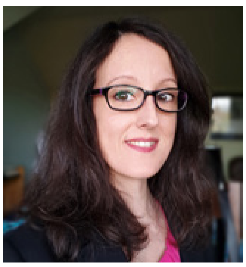
Measurement science is present in our day-to-day life and plays a fundamental role in the prevention, diagnosis, and treatment of a variety of diseases. Measurements must be accurate, reproducible, and repeatable to enable comparisons over time, as errors and uncertainties can result in false diagnoses and inadequate as well as harmful treatments. There is therefore a growing interest towards the implementation of standardisation and harmonisation initiatives in all areas of nuclear medicine to ensure equivalence of results and enable meaningful comparisons in single and multi-centre studies. This will not only improve the accuracy of clinical diagnosis and treatment decisions but will also contribute towards the delivery of cost-effective evidence-based medical interventions.

The European Association of Nuclear Medicine (EANM) is teaming up again with external partner societies to fully reflect the multidisciplinary nature of Nuclear Medicine. As part of the 34th Annual Congress (20-23 October 2021), the EANM Physics Committee has organised a Joint Symposium in collaboration with EFOMP on the topic of "Harmonisation and Standardisation in Nuclear Medicine". The session will begin with a clinician's view of the needs and added clinical value of improved reproducibility and explore the on-going efforts and challenges towards improving traceability in nuclear medicine through standardisation and harmonisation of clinical protocols. These include, but are not limited to, patient set-up, scan acquisition, image reconstruction, quantification and post-processing of SPECT/CT and PET/CT images. Standards for staging and response assessment as well as training and validation of models relying on radiomic features will also be discussed.

The session will be run virtually and will be accessible on-demand at any time for registered attendees. It will be chaired by Ana Denis-Bacelar from the National Physical Laboratory, the UK's national measurement institute, with the following expert panel of speakers:

- Sally Barrington (London, United Kingdom)
  The Need for Harmonisation and Standardisation in Nuclear Medicine
- Ronald Boellaard (Amsterdam, Netherlands)
  PET Harmonisation Beyond EARL
- Steffie Peters (Nijmegen, Netherlands)
  Towards Harmonisation of SPECT/CT
- Alex Zwanenburg (Dresden, Germany)
  Reproducible Radiomics Through Image Biomarker Standardisation

For more information on how to join us, visit the EANM website where you will find the preliminary congress programme and registration details. A flyer for the joint symposium can be found here.



Ana Denis-Bacelar on behalf of the EANM Physics Committee.

Ana Denis-Bacelar is a Senior Research Scientist at the UK's National Physical Laboratory, working towards the provision of accurate and reproducible measurement capabilities for nuclear medicine. She is also a member of the EANM Physics Committee and the EFOMP Special Interest Group for Internal Radionuclide Dosimetry.

Report on ESMPE online School on MRI Radiation Therapy Planning

Alberto Torresin writes about the second two-day online ESMPE School which took place on May 5th-6th 2021

Live Q&A session on the first day

Live Q&A session on the second day

The live webinar-based School was organised by EFOMP and the European School for Medical Physics Experts (ESMPE). It focused on the Medical Physics aspects of MRI Radiation Therapy Planning, with world-expert lecturers presenting the background, the practical methodology, the state-of-the-art and future developments of this new workflow in radiotherapy. An important aspect was that all of the lectures were delivered live (i.e. not pre-recorded) and a total of 264 students participated.

This important event was accredited by EBAMP (European Board of Accreditation for Medical Physics) as a CPD event for Medical Physicists at EQF Level 8, intended for Medical Physics Experts who wished to expand their knowledge in radiation therapy planning by using MRI.

The most important aspects of this innovative way of using MRI for treatment planning in radiation therapy were covered, including: MRI physics – basic and advanced; artefacts and spatial distortion; pulse sequences for RT planning; hardware and software for MRI RT planning; image segmentation techniques; MRI in external beam, gamma knife and brachytherapy planning; workflow and quality control; real-time MR-guided external beam radiation therapy.

Finally, a major scientific (and not just commercial) contribution has also been given by companies working in the area, including Varian, Raysearch, Scandidos, Philips/Elekta.

At the end of each presentation, questions from the students provided useful suggestions for a better understanding of the specific topic. In addition, open discussion took place during round-table events with all the speakers, at the end of each day, addressing questions and points of discussion submitted by the attendees via the platform's chat (see the screenshots above).

A special thanks must be given to the two scientific coordinators of the course, David Lurie and Brendan McClean who have kindly helped me in identifying the best and most professional speakers.

The technical organization was excellent and a special thank you goes to Efi Koutsouveli and Christos Alexakos for their expertise and teamwork in putting together the online School. Recordings of the event will be made available to EFOMP Individual Associate Members (IAM) via the ESMPE online e-learning platform.

Alberto Torresin is Chair of ESMPE. He is the Head of the Medical Physics Department in the Physics Faculty, ASST Grande Ospedale Metropolitano Niguarda and Visiting Professor at the University of Milano, Italy. His professional focus is on the patient dosimetry, optimisation and radiation protection in x-ray modalities, quality assurance, imaging for radiotherapy, MRI, advanced MRI (fMRI, DTI) for planning in Neurosurgery. His research work is primarily related to radiological optimisation.

EFOMP e-learning

EFOMP's e-learning platform was launched in January 2019. It contains a wealth of information, including video recordings and pdfs of lectures given during all recent editions of the European School for Medical Physics Experts (ESMPE), as well as complete recordings of the many webinars organised by EFOMP and aligned organisations during 2020 and 2021.

New webinars will be organised in 2021 jointly with COCIR as well as ECMP2020 'Warm Up' ones.

Access to the EFOMP e-Learning platform is provided to all **Individual Associate Members (IAM) of EFOMP**. Becoming an IAM is very simple – just complete an online registration form and pay a subscription fee of €15 (renewable annually). You will receive immediate access to the e-Learning platform.

Registration as an EFOMP IAM is available to anyone, in any location (including outside Europe) who is interested in continuing and supplementing their education and training in Medical Physics.

Special Interest Group for Radionuclide Internal Dosimetry (SIGFRID)

Pablo Mínguez Gabiña from Barakaldo, Spain, writes about EFOMP's latest Special Interest Group

On October 6th 2020, a Zoom meeting on clinical dosimetry was organised with the support of the former president of EFOMP Marco Brambilla. The meeting was attended by 25 medical physics experts (MPEs) from 9 European countries who discussed scientific matters relating to radionuclide dosimetry and considered how to promote dosimetry in clinical practice. During the discussion, the need for a network of medical physicists working on radionuclide dosimetry emerged. Dr. Bambrilla commented on the possibility of setting up a Special Interest Group (SIG) within EFOMP, and the initiative was met with enthusiasm by those in attendance. One week after this first meeting, a proposal was sent to the EFOMP Board.

On February 8th 2021, the new president of EFOMP, Paddy Gilligan, announced the creation of a new SIG entitled "Radionuclide Internal Dosimetry", which would operate under the scientific committee of EFOMP and would be established as a permanent structure. This opened a one-month period for National Member Organisations (NMOs) to nominate members and for Individual Associate Members (IAMs) to join. Up to 85 MPEs applied to become members of the SIG during that period.

Screenshot of the SIG meeting held on 4th June 2021

On March 8th 2021, Prof. Gilligan opened the first SIG meeting by welcoming 60 participants from 19 countries. Prof. Manuel Bardiès, as the SIG convener, chaired the meeting. Administrative matters related to membership and participation to the Steering Committee (SC) were decided by direct vote of all participants. Nine members of the SIG volunteered to be part of the SC and were elected by direct vote of the attendees (Manuel Bardiès, Gerhard Glatting, Ernesto Amato, Carlo Chiesa, Steffie Peters, Caroline Stokke, Pablo Mínguez Gabiña, Glenn Flux and Ana Denis Bacelar). A to-do list was briefly presented, but could not be discussed further due to lack of time.

SC meetings were held on March 17th, April 7th, April 19th and April 28th. The first meeting was dedicated mostly to administrative matters.

After some brainstorming, the SIG on radionuclide dosimetry was renamed SIGFRID (SIG for Radionuclide Internal Dosimetry). The SIG operating procedures (including membership, composition and election of the Board, etc.) were finalised and can be found at this link. The Board, composed of Manuel Bardiès (Chair), Steffie Peters (Vice Chair) and Ernesto Amato (Secretary) was elected for a 3-year term. Priorities were then drafted from the proposals received during the kick-off meeting and discussed at following meetings. The summary is reported here, with the SC members responsible for these tasks:

1. Survey on the practice of clinical radionuclide dosimetry (S Peters and C Stokke)
2. Available resources, protocols, tools, bibliography,... (A Denis Bacelar)
3. Education on radionuclide dosimetry (M Bardiès and G Glatting)
4. Communication (P Mínguez Gabiña)
5. Scientific issues (E Amato)
6. EU matters (G Glatting)
7. Regulatory issues (C Chiesa)
8. Promotion of clinical radionuclide dosimetry (G Flux)

Most of these priorities will be worked on in collaboration with NMO representatives and the relevant EFOMP committee, and contacts are being established. All activities will rely on the active participation of SIG members. You are cordially invited to participate to these activities by becoming a member of the SIG.

How to become a SIG member:
The SIG is meant for networking professionals with an interest in radionuclide dosimetry.

Membership is open to all EFOMP members. The procedure is explained on the SIG pages of the EFOMP web site: https://www.efomp.org/index.php?r=pages&id=sigs

The application form and a brief CV should be sent to the SIG secretary: sec.sig_frid@efomp.org

Pablo Mínguez Gabiña has been a senior medical physicist at the Gurutzeta/Cruces University Hospital in Barakaldo, Spain, since 2005. He has also been a part-time professor at the faculty of engineering of the University of the Basque Country in Bilbao since 2011. He has been a member of the Dosimetry Committee of the European Association of Nuclear Medicine since 2019. He is also a member of the Steering Committee of SIGFRID.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Main Congress: Oct 20-23, 2021
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An inventory of commonly used institutional acronyms for the European Medical Physicist

Loredana Marcu, Carmel Caruana and Efi Koutsouveli provide an excellent resource for any medical physicist who finds themselves drowning in a sea of acronyms!

In our professional lives as medical physicists we often encounter various acronyms in different contexts related to medical physics that we are not familiar with. Whether educational, professional or research-and-development related, these institutional acronyms are found to be a hindrance if their meaning and importance is not known to the individual. To support medical physicists in recognising and understanding such acronyms, our group has collated the most relevant acronyms in a single, easily searchable reference list. The table below lists the acronyms in alphabetical order, giving their meaning, a short description of the respective institution, as well as the associated website where those interested can find more detailed information.

The table also contains a number of international organisations that European medical physicists should be familiar with. In addition, since we are living in a globalised world, we also list briefly the international and regional organisations for Medical Physics.

Acronym	Definition	Description	Website
AAPM	The American Association of Physicists in Medicine	AAPM is a scientific and professional organisation, founded in 1958, composed of more than 8000 scientists whose clinical practice is dedicated to ensuring accuracy, safety and quality in the use of radiation in medical procedures such as medical imaging and radiation therapy.	https://www.aapm.org/
ACR	American College of Radiology	The ACR was founded in 1923, being at the forefront of radiology evolution, representing nearly 40,000 radiologists, radiation oncologists, nuclear medicine physicians and medical physicists. Purpose: to serve patients and society by empowering members to advance the practice, science and professions of radiological care.	https://www.acr.org/
AFOMP	Asia-Oceania Federation of Organizations for Medical Physics	AFOMP promotes the cooperation and communication between medical physics organizations in the Asia-Oceania region.	https://afomp.org
ALFIM	Latin American Medical Physics Association	ALFIM encompasses the Latin American medical physics associations to promote the profession in the region.	http://alfim.net/
ALLIANCE	European Radioecology Alliance	The ALLIANCE maintains and enhances radioecological competences and experimental infrastructures in Europe, with an international perspective, and addresses scientific and educational challenges related to the assessment of the impact of radioactive substances on humans and the environment.	http://er-alliance.org/
ARBR	Applied Radiation Biology and Radiotherapy Section	A section that is part of the Division of Human Health, IAEA	https://www.iaea.org/
ASTRO	American Society of Radiation Oncology	An organisation in radiation oncology dedicated to improving patient care through professional education and training, support for clinical practice and health policy standards, advancement of science and research and advocacy.	https://www.astro.org/
BIR	British Institute of Radiology	BIR is the international membership organisation for everyone working in imaging, radiation oncology and the underlying sciences.	https://www.bir.org.uk/

CCRI	Consultative Committee for Ionizing Radiation	Committee within BIPM - The International Bureau of Weights and Measures	https://www.bipm.org/en/committees/cc/ccri/members-cc.html
CERN	European centre for nuclear research (Conseil Européen pour la Recherche Nucléaire)	CERN's primary research is in fundamental particle physics; applied research in medical fields is also undertaken	https://home.cern/
CIRSE	Cardiovascular and Interventional Radiological Society of Europe	CIRSE is a non-profit, educational and scientific association aiming to improve patient care through the support of teaching, science, research and clinical practice in the field of cardiovascular and interventional radiology.	https://www.cirse.org/
CNRS	National centre for scientific research	France-based research centre (Le Centre national de la recherche scientifique)	http://www.cnrs.fr/
COCIR	European Trade Association of industries	European Trade Association representing the medical imaging, radiotherapy, health ICT and electromedical industries	https://www.cocir.org/
CONCERT	European Concerted Programme on Radiation Protection Research	Aims to contribute to the sustainable integration of European and national research programs in radiation protection	https://www.concert-h2020.eu/en
COST action	European Cooperation in Science and Technology	A funding organisation for research and innovation networks.	https://www.cost.eu/
CRCE	Centre for Radiation, Chemical and Environmental Hazards	Part of Health Protection Agency (HPA)	https://www.gov.uk/guidance/radiation-products-and-services
DITTA	Global Diagnostic Imaging, Healthcare IT and Radiation Therapy Trade Association	A global industry voice for diagnostic imaging, radiation therapy, healthcare IT, electromedical equipment and radiopharmaceuticals, representing more than 600 medical technology manufacturers, committed to improving health care and patient outcomes.	https://globalditta.org/
DMRP	Dosimetry and Medical Radiation Physics Section	A section of the Division of Human Health, IAEA	https://www.iaea.org/
EAN	European ALARA Network	The aim of EAN is to further specific European research on topics dealing with optimization of all types of occupational exposure, as well as to facilitate the dissemination of good ALARA practices within all sectors of the European industry and research.	https://www.eu-alara.net/
EANM	European Association of Nuclear Medicine	EANM's vision is to optimise and advance science and education in nuclear medicine for the benefit of public health and humanity within the concept of personalised healthcare and acts as an umbrella organisation for individuals as well as national societies.	https://www.eanm.org/
EBAMP	European Board for Accreditation in Medical Physics	EBAMP accredits medical physics education and training events. It does this by allocating Continuous Professional Development (CPD) credits depending on the number of hours of education and hands-on training required of participants.	www.ebamp.eu
ECRF	EORTC Cancer Research Fund	ECRF advances EORTC's mission by directly funding EORTC's cancer research and education program.	https://www.eortcresearchfund.org/
ECMP	European Congress of Medical Physics	Medical Physics Congress organised under EFOMP's umbrella every two years	https://www.efomp.org/index.php?r=pages&id=ecmp
EEA	European Environment Agency	EEA provides sound, independent information on the environment for those involved in developing, adopting, implementing and evaluating environmental policy, and also the general public.	https://www.eea.europa.eu/
EEB	EFOMP's Examination Board	EEB has been established to facilitate the harmonisation of Medical Physics education and training standards throughout Europe. EEB introduces the European Diploma of Medical Physics (EDMP) and the European Attestation Certificate to those Medical Physicists that have reached the Medical Physics Expert level (EACMPE)	https://www.efomp.org/index.php?r=pages&id=eeb-about
EFOMP	European Federation of Organizations for Medical Physics	The umbrella organisation for medical physics professional associations in Europe.	www.efomp.org
EFRS	European Federations of Radiographers societies	It was founded in 2008 by 27 professional societies of radiographers.	https://www.efrs.eu/
EJMP	European Journal of Medical Physics	The official journal of EFOMP. The owner of the journal is the Italian Association of Medical Physics (AIFM) and it is also the official organ of the French (SFPM), Irish (IAPM), Czech Republic (CAMP) and Hellenic (HAMP) Societies of Medical Physics.	https://www.physicamedica.com

EMPnews	EFOMP Newsletter	The purpose of the newsletter is to provide a communications forum for medical physics organisations, companies and for medical physicists, across Europe. EMP News is published quarterly (March, June, September, December) and is distributed electronically, not just within Europe but around the world.	https://www.efomp.org/index.php?r=fc&id=emp-news
EMRAS	Environmental Modelling for Radiation Safety	The activities of EMRAS focused on areas where uncertainties remain in the predictive capability of environmental models, notably in relation to the consequences of releases of radionuclides to particular types of environment.	http://www-ns.iaea.org/projects/emras/
ENEN	European Nuclear Education Network	The main purpose is the development of expertise in the nuclear fields through higher education and training in Europe via cooperation between universities, research organisations, regulatory bodies, the nuclear industry and any other organisations involved in the application of nuclear science and ionising radiation.	https://enen.eu/
ENEN+	European Nuclear Education Network plus	An EU funded project the aim of which is to attract, retain and develop young people to the nuclear and radiation fields.	https://plus.enen.eu/
ENETRAP projects	European Network on Education and Training in RAdiological Protection	Objectives: (1) to better integrate existing education and training activities in the European radiation protection infrastructure to combat the decline in both student numbers and teaching institutions; (2) to develop and implement more harmonised approaches for education and training in radiation protection in Europe; (3) to better integrate the national resources and capacities for education and training; (4) to provide competence and expertise for the continued safe use of radiation in industry, medicine and research.	https://enetrap.sckcen.be/en
EORTC	European Organization for Research and Treatment of Cancer	EORTC's mission is to improve the quality of life and survival rates of cancer patients.	https://www.eortc.org/
ERA	European Research Area	The European Research Area (ERA) has the aim to create a single, borderless market for research, innovation and technology across EU.	https://ec.europa.eu/info/index _ en
ERA-NET	European Research Area Net	Research programme through a network of national and regional players in a specific area part-funded by EU.	https://ec.europa.eu/programmes/horizon2020/en/h2020-section/era-net
ERC	European Research Council	ERC offers competitive funding and supports investigator-driven frontier research across all fields.	https://erc.europa.eu/
ERIC	European Research Infrastructure Consortium	A legal framework created by the European Commission to allow the operation of Research Infrastructures of Pan-European interest.	https://ec.europa.eu/info/research-and-innovation/strategy/european-research-infrastructures/eric/eric-landscape _ en
ESMPE	European School for Medical Physics Experts	ESMPE organises medical physics education and training events in person and virtual specifically targeted to Medical Physicists who are already Medical Physics Experts or would like to achieve Medical Physics Expert (MPE) status.	https://www.efomp.org/index.php?r=pages&id=esmpe-about
ESMRMB	European Society for Magnetic Resonance in Medicine and Biology	The society aims to support educational activities and research in the developments or the introduction of magnetic resonance techniques in the fields of medicine and biology.	https://www.esmrmb.org/
ESR	European Society of Radiology	Founded in 2005, by merging the European Congress of Radiology (ECR) and the European Association of Radiology (EAR), ESR is an apolitical, non-profit organisation dedicated to strengthening and unifying European radiology.	https://www.myesr.org/
ESRF	European Synchrotron Radiation Facility	The ESRF works with research institutions across Europe to support the development of the European Research Area and to promote science education.	https://www.esrf.fr/
ESTRO	European Society for Therapeutic Radiology and Oncology	ESTRO advocacy activities range from scientific projects, awareness campaigns, tools to empower the RT community, for radiation oncology to be recognized as a major contributor to cancer cure.	https://www.estro.org/
EURADOS	European Radiation Dosimetry Group	Is a non-profit association for promoting research & development and European cooperation in the field of the dosimetry of ionizing radiation.	https://eurados.sckcen.be/
EURAMED	European Alliance Medical Radiation Protection Research	Promotes research, teaching and publication of scientific and professional information, especially a strategic research agenda in the field of medical radiation protection research.	https://www.euramed.eu/
EURATOM	European Atomic Energy Community	Euratom regulates the European civil nuclear industry; it safeguards nuclear materials and technology, facilitates investment, research and development, and ensures equal access to nuclear supplies, as well as the correct disposal of nuclear waste and the safety of operations.	https://ec.europa.eu/energy/topics/nuclear-energy _ en
EUREKA	European Research Coordination Agency	The largest public network for international cooperation in R&D and innovation, present in over 45 countries.	https://www.eurekanetwork.org/

EUSOMII	European Society of Medical Imaging Informatics	Aims to connect radiologists, radiology residents, data scientists and informatics experts, also welcoming other specialties that use imaging such as pathology, dermatology and ophthalmology.	https://www.eusomii.org/
EUTEMPE-NET	EUropean Training and Education for Medical Physics Experts Network	A European consortium whose aim is to develop and deliver comprehensive educational and training modules to help young medical physicists achieve Medical Physics Expert status. Originally an EU funded project.	http://eutempe-net.eu/
EUTERP Foundation	European Training and Education in Radiation Protection foundation	A foundation dedicated to the provision of radiation protection training information for RPEs, RPOs and radiation workers. Closely associated with the ENETRAP projects.	http://www.euterp.eu
FAMPO	Federation of African Medical Physics Organizations	FAMPO is the regional federation of the International Organization for Medical Physics (IOMP) in Africa. FAMPO is a non-profit-making organization established in March 2009 to promote the application of physics in medicine.	www.fampo-africa.org
GEC-ESTRO	The Groupe Européen de Curiethérapie (GEC) and the European SocieTy for Radiotherapy & Oncology (ESTRO)	The GEC-ESTRO Committee supervises and coordinates all activities of GEC-ESTRO on a regular basis, in particular is responsible for: Research and Development; Brachytherapy publications; Representation on ESTRO bodies; Liaison with brachytherapy societies outside ESTRO.	https://www.estro.org/About/ESTRO-Organisation-Structure/Committees/GEC-ESTRO-Committee
HERCA	Heads of European Radiological Competent Authorities	HERCA, created in 2007, is a voluntary association of the Radiation Safety Authorities in Europe where they work together in order to identify common significant radiation protection issues and propose harmonization and/or practical solutions towards a common approach for these issues, whenever possible.	https://www.herca.org/
IADMFR	International Association of DentoMaxilloFacial Radiology	IADMFR, founded in 1968 aims to promote the advancement of research and education in DentoMaxilloFacial Radiology; to develop clinical services in the field of DentoMaxilloFacial Radiology; to encourage research in the allied diagnostic fields.	https://iadmfr.one/
IAEA	International Atomic Energy Agency	The IAEA is the international center for cooperation in the nuclear field. The Agency works with its Member States and multiple partners worldwide to promote the safe, secure and peaceful use of nuclear technologies.	https://www.iaea.org/
ICNIRP	International Commission on Non-Ionizing Radiation Protection	ICNIRP, founded in 1973, aims to protect people and the environment against adverse effects of non-ionizing radiation; develops and disseminates science-based advice on limiting exposure to non-ionizing radiation.	https://www.icnirp.org/
ICRP	International Commission on Radiological Protection	ICRP was established in 1928 to respond to growing concerns about the effects of ionizing radiation being observed in the medical community. Since 1959, ICRP publishes its own series of reports - Annals of the ICRP.	https://www.icrp.org/
ICRU	International Commission on Radiation Units and Measurements	ICRU, established in 1928, aims to develop and promulgate internationally accepted recommendations on radiation related quantities and units, terminology, measurement procedures, and reference data for the safe and efficient application of ionizing radiation to medical diagnosis and therapy, radiation science and technology, and radiation protection of individuals and populations.	https://www.icru.org/
ICTP	International Centre for Theoretical Physics	The Abdus Salam International Centre for Theoretical Physics has as its mission to foster the growth of advanced studies and research in physical and mathematical sciences, especially in support of excellence in developing countries.	https://www.ictp.it/
IEC	International Electrotechnical Commission	IEC's mission, since its foundation in 1906 is to achieve worldwide use of IEC International Standards and Conformity Assessment systems to ensure the safety, efficiency, reliability and interoperability of electrical, electronic and information technologies, to enhance international trade, facilitate broad electricity access and enable a more sustainable world.	https://www.iec.ch/homepage
IHE	Integrating the Healthcare Enterprise	IHE is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information. IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical needs in support of optimal patient care.	https://www.ihe.net/
IOMP	International Organization for Medical Physics	IOMP represents over 27,000 medical physicists worldwide. Its mission is to advance medical physics practice worldwide by disseminating scientific and technical information, fostering the educational and professional development of medical physicists, and promoting the highest quality medical services for patients.	https://www.iomp.org/
IRPA	International Radiation Protection Association	IRPA is an association of radiation protection professionals joining through national and regional radiation protection societies; promotes the worldwide enhancement of professional competence, radiation protection culture, and practice by providing benchmarks of good practice, and encouraging the application of the highest standards of professional conduct, skills, and knowledge for the benefit of individuals and society.	https://www.irpa.net/

ISO	International Organization for Standardization	ISO is an independent, non-governmental international organization with a membership of 165 national standards bodies. It brings together experts to share knowledge and develop voluntary, consensus-based, market relevant International Standards that support innovation and provide solutions to global challenges.	https://www.iso.org/home.html
ISR	International Society of Radiology	The International Society of Radiology is an NGO in official relation with the World Health Organization. The mission of the ISR is to facilitate the global endeavors of the ISR's member organizations to improve patient care and population health through medical imaging.	https://www.isradiology.org/
ISRRT	International Society of Radiographers and Radiological Technologists	Founded in 1962, ISRRT is the only organisation representing all disciplines of Medical Radiation Technologists internationally.	https://www.isrrt.org/
IUPESM	International Union for Physical and Engineering Sciences in Medicine	Its constituent organisations are the International Federation for Medical and Biological Engineering (IFMBE) and the International Organization for Medical Physics (IOMP). IUPESM organizes the very important World Congress on Medical Physics & Biomedical Engineering.	www.iupesm.org
MEDRAPET	MEdical RAdiation Protection Education and Training project	The overall aim of this EU funded project was to improve the harmonization of the radiation protection education and training of medical and healthcare professionals in the EU Member States in the light of 2013/59/EURATOM. The MEDRAPET guidance document was published by the European Commission as Radiation Protection Series 175. Its full title is: Guidelines on radiation protection education and training of medical professionals in the European union.	https://ec.europa.eu/energy/sites/ener/files/documents/175.pdf
MEFOMP	Middle East Federation of Organisations for Medical Physics	The mission of the Middle East Federation of Medical Physics (MEFOMP) is to advance medical physics practice throughout the Middle East by disseminating scientific and technical information, fostering the educational and professional development of medical physics, and promoting the highest quality medical physics services for patients.	www.MEFOMP.com
MELODI	Multidisciplinary European Low Dose Initiative	MELODI is an European Platform dedicated to low dose radiation risk research having the following goals: (1) to propose R&T priorities for Europe in its field of competence; (2) to seek the views of stakeholders on the priorities for research, keep them informed on progress made, and contribute to the dissemination of knowledge; (3) to interface with international partners like WHO and IAEA.	http://www.melodi-online.eu/
MSCA	Marie Sklodowska-Curie Action	The MSCA provides grants for all stages of researchers' careers and encourages transnational, intersectoral and interdisciplinary mobility.	https://ec.europa.eu/programmes/horizon2020/en/h2020-section/marie-sklodowska-curie-actions
NCRP	National Council on Radiation Protection and Measurements	NCRP supports radiation protection by providing independent scientific analysis, information, and recommendations that represent the consensus of leading scientists.	https://ncrponline.org/
QUATRO	Quality Assurance Team for Radiation Oncology	QUATRO - as part of IAEA services - provides independent quality audits through comprehensive reviews of radiotherapy practices.	https://www.iaea.org/services/review-missions/quality-improvement-quality-assurance-team-for-radiation-oncology-quatro
ROG	Radiation Oncology Group	Part of EORTC	https://www.eortc.org/blog/category/radiation-oncology-group/
RSNA	Radiological Society of North America	RSNA is a non-profit organization with over 52,000 members from 153 countries around the world that provides high-quality educational resources, including continuing education credits toward physicians' certification maintenance.	https://www.rsna.org/
SEAFOMP	South East Asian Federation of Organizations for Medical Physics	Includes the south-east Asian organizations for medical physics to promote the profession in that region.	http://seafomp.org/home/
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation	UNSCEAR was established by the General Assembly of the United Nations in 1955. Its mandate is to assess and report levels and effects of exposure to ionizing radiation. Governments and organizations throughout the world rely on the Committee's estimates as the scientific basis for evaluating radiation risk and for establishing protective measures.	https://www.unscear.org/
WHO	World Healthcare Organization	WHO is the directing and coordinating authority on international health within the United Nations system.	https://www.who.int/
WIN Global	Women in Nuclear Global	Women in Nuclear Global (WiN Global, founded in 1993) is a global organization which supports and encourages women working in nuclear science and its applications throughout the world, particularly energy and radiation applications. WiN Global aims to promote understanding and public awareness of the benefits of nuclear and radiation applications through a series of active networks — at chapter, national, regional and international levels.	https://win-global.org/

Loredana G. Marcu is Professor of Medical Physics at the University of Oradea, Romania and Adjunct Professor at School of Health Sciences, University of South Australia. She is a radiotherapy medical physicist, being educated and trained in Adelaide, South Australia, where she also worked as a TEAP (Training Education and Accreditation Program) preceptor supervising and co-ordinating the medical physics training and education of the junior physicists in South Australia. Her current research interests cover in silico modelling of tumour growth and response to treatment, radiobiology, targeted therapies, and the risk of second cancer after radiotherapy. Loredana Marcu is involved in several professional activities being a member of the Women in Medical Physics and Biomedical Engineering Task Group within IUPESM. She has been member/chair of the organising/scientific committee of 12 national and international conferences. Since 2018 she is the president of the Romanian College of Medical Physicists (CFMR).

Carmel J. Caruana is Full Professor and Head of Medical Physics at the University of Malta, Professor Caruana specializes in diagnostic and interventional radiology, radiation protection, medical devices, physical agents and legislative, professional and education and training issues in Medical Physics. He is past-chairperson of the Education and Training Committee of EFOMP, lead author of the role and education and training chapters of the EU document 'European Guidelines on the Medical Physics Expert', lead author of the EFOMP policy statements on education and training (PS12.1) and the role of the Medical Physicist (PS16) and past Associate Editor for Educational and Training and Professional issues for Physica Medica. In 2020 he published the first ever book on leadership in medical physics entitled 'Leadership and Challenges in Medical Physics: A Strategic and Robust Approach' (https://iopscience.iop.org/book/978-0-7503-1395-7).

Efi Koutsouveli is a Medical Physicist in the Medical Physics department of Hygeia Hospital, Athens, Greece since 1993. Her professional focus is on quality assurance, dosimetry, radiation protection of radiotherapy units (external radiotherapy & brachytherapy), pediatric, stereotactic radiotherapy, radiosurgery treatments and patient safety. She is also active in the training of young Medical Physicists, Radiation Oncologists, Radiation Therapists, Nurses, Administrative staff. Her special interest is on Hospital Quality Management Systems, Oncology Information Systems, Radiotherapy Quality Audits and she is serving on multiple hospital quality committees since 1996. Currently, she is the Treasurer of the Hellenic Association of Medical Physicists (HAMP), the HAMP-ESTRO liaison person and the HAMP delegate to EFOMP. Since January 2021 she has been Secretary General of EFOMP. In 2019, she received the IOMP-IDMP award for promoting medical physics to a larger audience.

HERCA work on DAP units and on article 78.2 of the BSS Directive 2013/59

Medical Physics Expert Alexandra Karoussou-Schreiner from Luxembourg provides an overview of work undertaken to standardise dose area product units

A collaboration between the HERCA working group on Medical Applications (WGMA) and COCIR was established in 2011. This collaboration led to an important amount of work being accomplished in CT dose optimisation, management and reporting as well as establishing long term collaboration between COCIR and other stakeholders. The results of this collaboration have been summarized in a comprehensive report in 2017 (1).

This collaboration has led to further work being carried out by focusing on two key areas:

- The standardisation of dose area product (DAP) units in radiology,
- The information to be provided to undertakings required under article 78.2 of the BSSD

The Standardisation of DAP units
HERCA proposed that the following DAP units be adopted in 2012 (2):

- Gy.cm^2 for interventional radiology
- mGy.cm^2 for general radiography

In 2013, HERCA contacted IEC and COCIR requesting that the industry consider harmonising DAP units in radiology. HERCA also had contact with EFOMP, which expressed support of this initiative.

As an outcome of this work, in 2019, IEC published two standards:

- The IEC 60580 on Medical Electrical Equipment-Dose Area Product Meters standard. In this standard some of the modifications requested by HERCA were introduced.
- The IEC 60601-2-43 standard (X-ray equipment for interventional procedures). This standard contains the following additional requirement related to DAP units in its subclause 203.6.4.5:

Means shall be provided to the responsible organisation to allow configuring the unit for display of dose area product at least among all the following:

– Gy•cm^2,
– μGy•m^2 or cGy•cm^2,
– mGy•cm^2.

The information required to be provided to the undertaking by the manufacturer under article 78.2 of the BSSD

Article 78.2 of the BSSD requires the undertaking to be provided with adequate information on the risk assessment for patients.

In 2018 the HERCA representatives met with COCIR to discuss what information manufacturers provide to the undertaking. HERCA representatives felt that the information provided by manufacturers did meet the criteria set out in Article 78.2 but that the format in which it was provided was not 'user-friendly' and, in practice, was not used by undertakings. It was considered that the work should first concentrate on radiotherapy equipment as the risks with these types of equipment are greater than for other types of equipment and radiotherapy is the modality that requires prior risk assessment according to the BSSD (Article 63).

COCIR agreed to produce a document that summarised all the radiation risks included in the information which is given to the undertakings, usually in the form of user manuals, into a user-friendly format that would also better address the BSSD requirement of the Article 78.2. This document would allow undertakings to get an overview of all the radiation risks for patients for each particular radiotherapy equipment and allow them to include them in their prior risk assessments.

COCIR agreed to work with ESTRO and EFOMP to develop a format of the document which would then be used by all manufacturers for all radiotherapy equipment.

COCIR shared the final version of the document, jointly produced with ESTRO and EFOMP, with HERCA in September 2019. The document included templates that undertakings and manufacturers can use to summarise the radiation risks related to the use of external beam radiotherapy (including proton beam therapy) and brachytherapy equipment.

This template document is aimed at being used by any radiation therapy manufacturer to present the risks for patients for each radiotherapy equipment. This work has resulted in the publication of the jointly developed Guidelines for manufacturers from COCIR, EFOMP and ESTRO to assist manufacturers and undertakings in meeting the requirements of articles 78.2 and 63 of the BSS Directive 2013/59 respectively.

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(2) https://www.herca.org/herca_news.asp?newsID=23

Alexandra Karoussou-Schreiner, works as a medical physics expert, regulator and inspector at the radiation protection department of the ministry of health in Luxembourg. She is currently the chair of the HERCA working group on medical applications and has led the work carried out in collaboration with COCIR since 2013.

Why seek approval of National Registration Schemes by EFOMP?

In this article Brenda Byrne and Ad Maas make the strong case for EFOMP approval of national medical physicist registration schemes

Medical Physics is a health profession where physical principles are applied in medicine for the benefit of patient care, both concerning efficacy and efficiency of diagnosis and treatment. The physical principles include optics, mechanics, electricity and magnetism and last but not least nuclear physics. Nuclear physics in Medical Physics is mostly directed toward application of ionising radiation in medicine for the benefits of patients. The key role of the Medical Physics Expert (MPE) in safe and effective use of ionising radiation in medicine is widely recognised in European reference documents like the EU Council Directive 2013/59/EURATOM (2014), and European Commission Radiation Protection No. 174, European Guidelines on Medical Physics Expert (2014).

One of the most common queries to the Professional Matters Committee regards the possibility to get a Medical Physics Expert (MPE) certificate in one European country if an MPE certificate was already obtained in another European country. Unfortunately, there is no automatic recognition of MPE certification between European Countries since the role of Medical Physics Expert is not one of the professions recognised by the European Union (EU) in Directive 2005/36/EC which enables the free movement of professionals such as doctors or nurses within the EU. EFOMP wants to change that but in order to do this we need to ensure harmonisation of education and training of MPEs across Europe. The first step to ensure harmonisation is the approval of the national registration schemes (NRS) for MPEs in each National Member Organisation (NMO). Now is the opportunity for our profession to take our future in our own hands and seek recognition from the EU and European countries outside the EU as a recognised profession but we can only do this with the support of the NMOs.

EFOMP have a long history of approval of NRS for MPEs dating back to 1990s. In 2018, following the publication of European Guidelines on Medical Physics Expert (RP174) and the EU Council Directive 2013/59/Euratom, EFOMP introduced a new procedure to approve NRS for NMOs to ensure that the education and training of MPEs included the knowledge, skills and competencies as outlined in RP174. NMOs can access the available application form and procedure for NRS approval on the EFOMP website here.

A recent survey completed by the Professional Matters and Education and Training Committee on the status of NRS in NMOs, showed that 22 NMOs have a system for education, training and registration of MPEs in place and therefore should be eligible to apply for NRS approval. With the implementation of EU Council Directive 2013/59/EURATOM into national laws in each NMO, we expect the number of NMOs with an NRS to increase. As of May 2021, 5 NMOs have applied for approval of their NRS and all of them were approved after a thorough evaluation of the underlying documents. We are strongly encouraging those NMOs with an NRS in place to apply for approval of their NRS by EFOMP. The application process is simple and well defined. The Professional Matters committee can be contacted directly if there are any queries regarding the process and the committee may offer help/advice in cases where some of the criteria for approval are not met.

NRS approval by EFOMP does not guarantee that MPE registrations are accepted by other NMOs, but still it is an important step forward. If we have at least 70 % of the NMOs with an EFOMP approved NRS in place, we can seek approval from the EU to recognise and protect the title of MPE and establish MPEs as a profession recognised by EU in Directive 2005/36/EC. This can only benefit our profession by allowing MPEs to transfer their qualifications and skills between NMOs and prevent unqualified personnel from using the title MPE. Finally, this will benefit patient care in a more efficient and cost-effective way than the Medical Device Regulation.

Brenda Byrne is a Medical Physics Expert and Radiation Protection Expert in the Mater Misericordiae University Hospital, which is a busy teaching hospital in Dublin, Ireland. Her primary areas of interest are diagnostic radiology, nuclear medicine and radiation protection. She completed her undergraduate and postgraduate studies in Trinity College Dublin. Brenda is an occasional lecturer with the University College Dublin, School of Diagnostic Imaging and the Royal College of Surgeons, Faculty of Radiology, Dublin. In February 2019, Brenda undertook the EFOMP EUTEMPE Course MPE01 Leadership in Medical Physics, Development of the profession and the challenges for the MPE. She is now a module co-leader for this course. Brenda was elected as Vice-Chairperson of the EFOMP Professional Matters Committee in October 2019 and took over the role of Chairperson in January 2021.

Ad Maas is now a retired medical physicist expert after 35 years working in the Jeroen Bosch Ziekenhuis, a general hospital in 's-Hertogenbosch, Netherlands. From 2018 to 2020 he was chair of the EFOMP Professional Matters Committee working on a new procedure for international approval of national registration schemes for medical physicist experts. His main interests are hospital physics, hospital safety, quality systems, operating room, intensive care and cardiac pacing. Ad Maas is now a member of MREC Brabant (Medical Research and Ethics Committee) as an expert on medical devices and member of the Board of VITHaS, a society for technicians in cardiac pacing.

RESEARCH ARTICLE

Metallic Magnetic Calorimeters for precision measurements of radioisotopes: the European project MetroMMC

Members of the MetroMMC consortium

Radioactive isotopes are widely used by the medical community for diagnostic imaging and radiation therapy. Examples include ^{99}mTc used for planar scintigraphy and SPECT imaging, ^{18}F, ^{13}N, ^{11}C, ^{82}Rb used for PET imaging. Other radioisotopes are used for internal radiotherapy where they are bound to a vector (antibodies, peptides, folates, etc.) to target molecule receptors that are present at the surface of the tumour cells or relevant biomolecules overexpressed in the development of a pathological process. Among the most commonly used there are β-emitting radiation like ^{131}I, ^{90}Y, ^{177}Lu with a range of several millimetres in human tissues or α-emitters such as ^{213}Bi, ^{225}Ac, ^{223}Ra, and ^{211}At, with a range of tens of micrometres, which can target leukemias and small micrometastatic deposits of cancer cells.

The efficacy of a radioisotope depends on its chemical and physical properties. The latter includes the types of radiation emitted, branching ratios, radiation energy, intensity, and radioactive lifetimes. These quantities are known as nuclear/atomic data and are direct input in calculations of internal radiation-dose estimates for radionuclides used in nuclear medicine. Moreover, the data is essential for reliable activity determination using various modern methodologies. Accurate measurement of these properties is key to guarantee the safe and effective use of radioisotopes. It is also crucial in the development of new radio pharmaceutics that can expand and improve that range of internal therapy treatments currently available and reduce treatment costs. The study of production and characterisation of radioisotopes is a very active field in applied nuclear and radiation physics.

The European project MetroMMC [1] is focused on the development of metallic magnetic calorimeters (MMC) detectors for precision measurement of nuclear data for a variety of applications including nuclear medicine. Such technology is capable of measuring radiation with unprecedented energy resolution and in a low-energy range that is normally inaccessible (sub keV). It also investigates the measurement of the probability of a nuclear proton to capture an atomic electron

(electron-capture decay, EC). This process results in a proton changing into a neutron with emission of a neutrino, and it is followed by emission of X-rays or/and atomic electrons. This is a common decay mode often present in PET isotopes. The process is notoriously difficult to characterise accurately because the electron vacancy created in an atomic level generates a complex cascade of X-rays and atomic electrons often involving thousands of atomic transitions that can be very close in energy. Due to the insufficient detector resolution, transitions often remain unobserved resulting in overall large uncertainties on measurements of emission probabilities. This situation is also reflected in an inaccurate measurement of the radiation dose per gram of radioisotope solution.

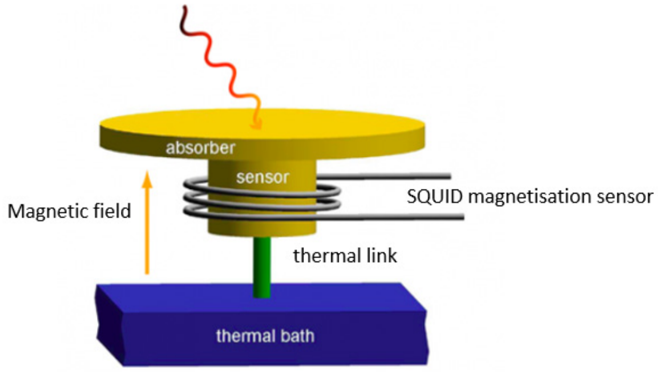

Figure 1: Schematic representation of calorimeter technique for radiation measurements. Figure adapted from Ref. [2].

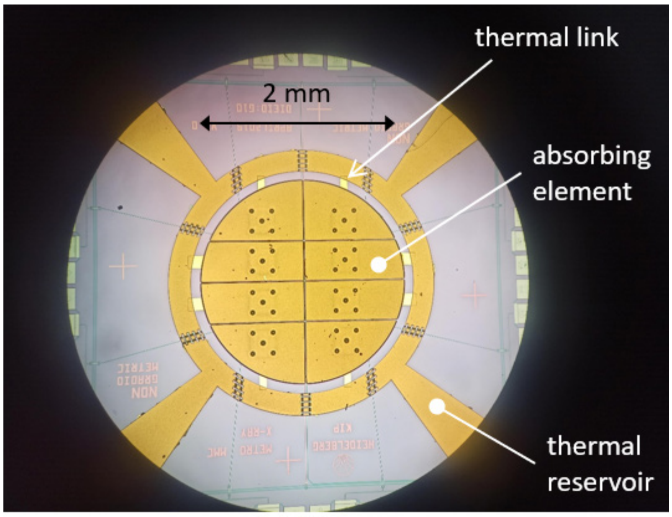

Figure 2: Picture of an MMC chip.

MMC detectors are microcalorimeters, i.e., devices that measure radiation energy based on the temperature increase that radiation causes when absorbed in a small mass of certain materials. The temperature increase is very small (billionth of a ^{0}C) requiring the absorbing element to be in contact with a thermal reservoir (a body at constant temperature) and a very sensitive temperature sensor.

In the case of our MMC, the temperature sensor is an alloy of Gold and Erbium immersed in a weak magnetic field (see Fig. 1). The change of temperature causes changes in the magnetic field that are picked up by a superconducting quantum interference device (SQUID) magnetometer [2]. Such a system needs to be operated at a cryogenic temperature of less than -273 ^{0}C. Fig. 2 shows the radiation absorber and Fig. 3 shows the full setup.

Figure 3: MMC detector setup at LNHB, France, with suspension for vibration decoupling. The MMC chip sits at the bottom of the cryogenic column.

As a part of the project, a novel calorimetry technique is also being developed where temperature changes are detected as frequency shifts in a microwave oscillator [3].
In parallel to these experimental developments, theoretical efforts are ongoing within MetroMMC to improve nuclear- and atomic-model description of EC with the inclusion of nuclear and atomic structure effects [4,5]. Despite the experimental improvements aimed at putting our knowledge of radioactive decay on solid experimental ground, part of the radiation will remain unobserved requiring theoretical description for the most accurate dose calculations.

One radioisotope that we are measuring as a part of this project is ^{125}I, which is widely used for low dose rate (LDR) brachytherapy for treating prostate or cervical cancers.

MetroMMC is run by three European institutes: Laboratoire National Henri Becquerel (LNHB, France), Physikalisch-Technische Bundesanstalt (PTB, Germany), and the National Physical Laboratory (NPL, UK), collaborating with the Korean Research Institute for Standards and Science (KRISS), and university partners: Nova University Lisbon (Portugal), Heidelberg University (Germany), and the Centre National de la Recherche Scientifique (CNRS, France). The consortium is coordinated by PTB, and combines expertise in detector fabrication, radiation metrology, quantum metrology, atomic- and nuclear-physics modelling.

Acknowledgment
This project 17FUN02 MetroMMC has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme.

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Dr Giuseppe Lorusso is a research scientist at the National Physical Laboratory and is a visiting lecturer at the University of Surrey, UK. His main research focus is precision measurement of nuclear and atomic data relevant for medical application, nuclear-reactor design, and fundamental physics such as nuclear structure and nuclear astrophysics. Measurements are performed at NPL as well as part of large international collaborations.

RESEARCH ARTICLE

Equivalent neutron dose dependence from the geometry of the second maze – MC simulations vs. measurements

Medical therapy accelerators working at energies higher than energy thresholds for (γ,n) nuclear reactions produce a measurable number of neutrons. Lead is one of the materials commonly used in accelerator heads, and the energy threshold for (γ,n) reaction is 6.7 MeV for the isotope ^{208}Pb. For radiation protection in radiotherapy departments, accelerators are installed in maze designed bunkers [1]. Standard geometry is with one band maze. Occasionally two band maze rooms are used. The purpose of this study was to analyse the dependence of the equivalent neutron dose from the geometry of the second band of the maze using dosimetric measurements of neutrons and Monte Carlo (MC) simulations.

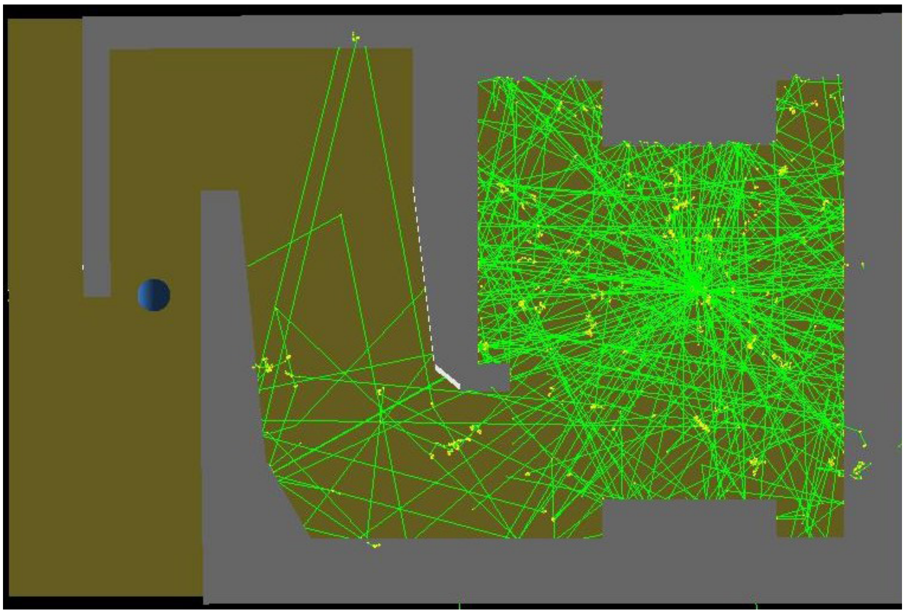
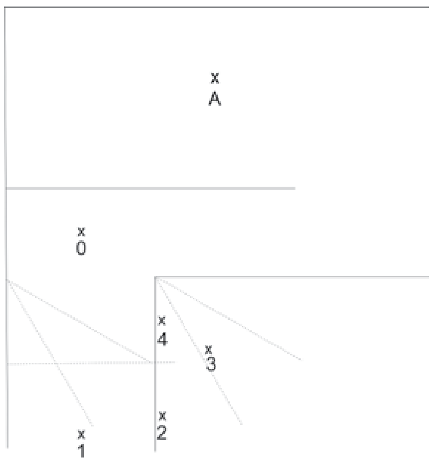


Figure 1: Reconstructed therapy vault in MC simulations.

Measurement of the neutron dose at a two-band maze therapy room was conducted using Meridian model 5085 survey meter (Health Physics Instrument, Goleta, CA), where Elekta Versa HD accelerator (Elekta, Crawley, UK) was installed with three photon energies (6 MV, 10 MV and 15 MV). Measurements were done for a 15MV photon beam only. MC simulations were performed using GEANT4 toolkit. Exact geometry of the therapy room was reconstructed using Constructive Solid Geometry (CGS). Particle gun was used as a primary generator of neutrons with Maxwell distribution. Neutrons were emitted isotropically from a sphere with a 60 cm diameter which was positioned in the isocenter. All simulations were performed using HadronPhysicsQGSP_BIC_HP and EMStandardPhysics physics lists [2]. As a dosimeter a PMMA sphere with 30 cm diameter was used (Fig 1). NIST compound database materials were used in all simulations. All dimensions of the vault were reconstructed using data provided by detailed construction drawing. Measured dose at the entrance door was used to obtain simulation parameters (number of primaries, etc.). In order to obtain the geometry dependence we changed the second band angle keeping the length, height and width the same as in reality. Dashed lines represent wall positions for different angles in MC simulations at Fig 2 (a).



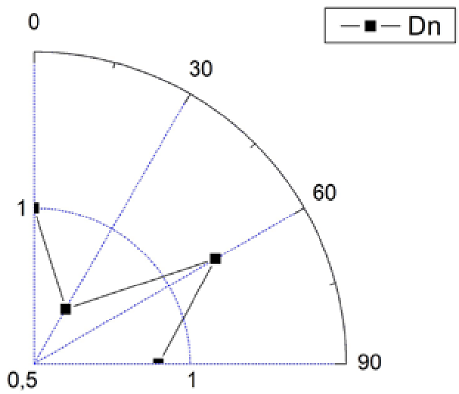


Figure 2: (a)Scheme of the two-band maze therapy room. A is the isocenter position. Measurement was conducted at position 1. MC simulation was performed for positions 1-4. Dashed lines represent wall positions for different angles in MC simulations. (b) Normalized neutron dose obtained from MC simulations.

Measured neutron dose at the entrance door was 0.0027 μSv (Fig 2a) [1]. We normalized the doses obtained from MC simulations to the measured one. Normalized neutron doses are depicted at Fig 2b. Our results show that the highest calculated dose was obtained for the 60° angle of the second maze. It is 17% higher than for the normal 0° angle. Possible explanation for this is the fact that the differential dose albedo (wall reflection coefficient) is highest for this angle [3]. For 30° it was 30% smaller and for 90° it was 10% smaller.

Although the lowest dose was obtained for 30° band angle with calculations, it was not very practical for clinical use. Clinically the most interesting would be the 90° angle which is practically a short three band maze. This geometry could be very promising, since it could offer a compact constructional solution, and better optimisation of the available space (resources).

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Tóth Árpád is at the Oncology Institute of Vojvodina, Sremska Kamenica, Serbia and Institute of Nuclear Sciences Vinča, Vinča Serbia. He received his Ph.D. in Nuclear Physics in 2018 from the University of Novi Sad, Serbia. He currently works as a Medical Physicist at the Oncology Institute of Vojvodina and is an associate researcher at Institute of Nuclear Sciences Vinča. He is a member of the Serbian Association of Medical Physicists, Council of the Hungarian Academy of Vojvodina and Hungarian Academy of Sciences. Besides clinical work, his main interest is MC simulations especially treatment room design, radiation protection and CBCT dose estimation.

WHAT MEDICAL PHYSICISTS DO IN THEIR FREE TIME

Leading group-fitness classes

Julie Haglund draws parallels between tips from the recent "Telling ain't Teaching" EFOMP-EUTEMPE webinar and her role as a fitness instructor

Julie leading an indoor cycling class

The first joint EFOMP-EUTEMPE webinar and masterclass in October 2020 diverged from standard topics like quality control and dosimetry, and instead introduced the community to Danielle Dobbe and her expertise about teaching, memory, and learning. We learned about the process of moving information from working memory into long term memory, and Danielle provided tips for making this transition quicker.

As a clinical medical physicist, my work does not regularly require me to teach, but when Danielle asked how many of us teach, I immediately thought about teaching in contexts other than academia. A teaching role I identified in my life is leading group fitness classes.

As an instructor, my first task is to be a student who learns and memorises choreography. One tip that I recognised in my study of choreography is making combinations of words and images. I make the choreography text visual by writing it in my own short-hand notation with words, arrows, and symbols. The act of writing engages me more in the process of learning. Retrieval practice, another learning tip, occurs when listening to the music without looking at my notes.

Variation or interleaving describes rearranging pieces of information in each study session instead of learning in sequence. It will be an exciting challenge to practice this technique by mixing the order of songs in a programme to see if it will actually be easier to remember the entire programme in the order it must be presented.

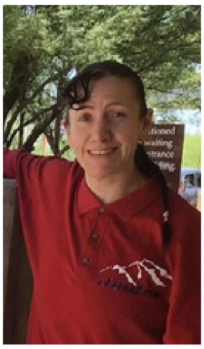
One tip for teaching others was to use examples and stories. Describing how an exercise is similar to movements that participants do in everyday life puts them into a story they can relate to so that they remember choreography.

One particularly interesting topic of the masterclass was four different types of feedback. Content feedback refers to the result of what has been done, and I think group fitness customers are diligent in telling if a class was good or bad. Person feedback refers to the person, and it is common to hear about a good or bad instructor.

Process feedback refers to what in the process went wrong and what to do to remedy the error. As medical physicists, we are trained to consider what in the measurement process produced an incorrect result. As an instructor, process feedback is important to use when evaluating negative content feedback. Taking the time to discover what in the process of delivering a class went wrong, or what part and for whom the class was not a good experience, will create change and make me a more robust instructor.

Self-regulation feedback refers to being aware of what you are doing, your strategy and approach, and I want to think in terms of this kind of feedback and use it more. Group fitness instructors who want to improve in their role are encouraged to film themselves while teaching. This is an uncomfortable task, but it is perhaps the best technique for seeing self-regulation and discovering what participants see you do or say.

This first EFOMP-EUTEMPE webinar and masterclass was engaging and entertaining, and I thank the organisers for their creativity in giving the community a unique first topic. If we are not teaching students, perhaps we are studying EFOMP courses ourselves, or even giving and receiving performance reviews at work. Investing time in this webinar and masterclass, and applying the tips about teaching and learning will make us more effective in a variety of situations.



Julie Haglund is a medical physicist presently working in radiation therapy at Centralsjukhuset in Karlstad, Sweden. Julie has taught group fitness classes at local gyms and holds certification as an instructor in Les Mills Sprint and Les Mills ToneCouncil of the Hungarian Academy of Vojvodina and Hungarian Academy of Sciences. Besides clinical work, his main interest is MC simulations especially treatment room design, radiation protection and CBCT dose estimation.

The Aurora project – informing about medical technology through comic strips

Note from the Editor: This is the latest comic strip from the Czech Republic's Aurora team, aimed at educating the public about the benefits of technology in medicine, in a highly-original way. This time, Lev the lion finds out about the Gleason score arising from his prostate biopsy

Aurora is a project of the Prague section of European Physical Society (EPS) Young Minds. The main aim of Aurora is to spread knowledge about ionizing radiation in general, ionizing radiation in medicine and cancer. And how do we intend to spread this knowledge? For example by creating topical comics. Our team is still expanding. Now, we have two main painters, Markéta Farníková and Anežka Kabátová. Then, there are four people who create stories for the comics, consult with the painters and translate texts, Barbora Dršková, Petra Osmančíková, Jana Crkovská and Anna Jelínek Michaelidesová. Anna is also the coordinator and the person in charge of the whole project.

The Aurora team grants permission and consent to EFOMP and EFOMP NMOs to use the comic strips for educational purposes. In case you would like to translate the comics into another language, email us the translated text and we will modify the comic and send it back to you. No other modifications to the content are allowed. You can contact the Aurora team at aurora@youngminds.cz

The Aurora team are:

Marketa Farníková studied Medical Physics at the Czech Technical University in Prague (CTU), gaining a MSc. degree in 2019. She has been working at the Department of Medical Physics at Hospital Na Homolce since 2018, at the Department of Radiation Dosimetry Nuclear Physics Institute of the Czech Academy of Sciences (CAS) where she has been working on her Ph.D. since 2019 and at the Department of Medical Physics at Motol University Hospital since 2020.

Anežka Kabátová studied Experimental Nuclear and Particle Physics at the CTU and received her MSc. degree in 2020. Since then, she has been working on her Ph.D. project on galaxy evolution at the Astronomical Institute of the CAS. She has been an active member of the Prague section of EPS Young Minds since 2017, acting as a vice-president of the section between 2018 and 2019.

Barbora Dršková finished the Medical Physics master programme at the CTU, Faculty of Nuclear Sciences and Physical Engineering in 2019. Since then, she has been working on her Ph.D. She works as a medical physicist in radiotherapy at General University Hospital in Prague and University Hospital Královské Vinohrady.

Petra Osmančíková graduated from the CTU and holds a MSc. and a Ph.D. degree in Medical Physics. She is a clinical medical physicist in radiotherapy in Motol University Hospital in Prague. She is also a researcher at the Faculty of Nuclear Physics and Physical Engineering of the CTU.

Jana Crkovska received her Ph.D. in High Energy Nuclear Physics from the Université Paris Sud in 2018. Since then, she has continued her research on charmed particles production at the Los Alamos National Laboratory. She is part of the LHCb Collaboration, one of the experiments at the Large Hadron Collider (LHC) in CERN.

Anna Michaelidesová received her MSc. and Ph.D. degree in Medical Physics from the Faculty of Nuclear Physics and Physical Engineering of the CTU. She has been working as a researcher at the Nuclear Physics Institute of the CAS since 2010. In the period 2012-2017, she was employed as a Medical Physicist at the Proton Therapy Center Czech. She has also been working as a researcher at the Faculty of Nuclear Physics and Physical Engineering of the CTU since 2019. From June 2019 until the end of 2020, she was a postdoctoral researcher at the department of Translational Radiooncology and Clinical Radiotherapy of the OncoRay® - National Center for Radiation Research in Oncology at the Medizinische Fakultät Dresden Carl Gustav Carus in Germany. She has been a member of the Prague section of EPS Young Minds and of the leadership committee of the IRPA YGN since 2019.

Upcoming Conferences and Educational Activities

This list was correct at the time of going to press.
For a complete, up-to-date list, please visit our **EVENTS WEB PAGE**

Jun 16th, 2021 - Jun 19th, 2021

EFOMP - 3rd European Congress of Medical Physics
Virtual

Jun 21st, 2021 - Jun 25th, 2021

Second European Nuclear Competition For Secondary School Pupils
Online

Jun 23rd, 2021 - Jun 25th, 2021

Journées Scientifiques de la Société Française de Physique Médicale
Virtual world organised by colleagues from Rennes

Jul 5th, 2021 - Jul 9th, 2021

2nd Enen Nuclear Summer School For Bsc And Msc Students
Online

Sep 2nd, 2021 - Sep 4th, 2021

ESHNR 2021
Online

Sep 19th, 2021 - Sep 22nd, 2021

ÖGMP, DGMP and SGSMP- three Medical Physics Societies conference
Online

Sep 20th, 2021 - Sep 24th, 2021

Innovative Radiotherapy Techniques - Isirt
Department of Physics - Università degli studi di Pavia,
Via Bassi 6, I-27100 Pavia
(Italy)

Oct 20th, 2021 - Oct 24th, 2021

EANM'21 - 34th Annual Congress of the European Association of Nuclear Medicin
Virtual

Nov 4th, 2021 - Nov 5th, 2021

BIR Annual Congress 202
London

Nov 4th, 2021 - Nov 6th, 2021

15th International Conference "Medical Physics in Baltic States 2021" & Congress (EFOMP school)
Kaunas University of Technology, Lithuania

Feb 3rd, 2022 - Feb 5th, 2022

Image Guided and Adaptive Radiotherapy in Clinical Practice Course 2022
The Royal Marsden NHS Foundation Trust, London, UK

May 30th, 2022 - Jun 3rd, 2022

6th European Congress on Radiation Protection
Budapest Congress Centre / Budapest, Hungary

Aug 17th, 2022 - Aug 20th, 2022

4th European Congress of Medical Physics (ECMP 2022)
Dublin, Ireland

Sep 21st, 2022 - Sep 24th, 2022

German Conference on Medical Physics
Aachen, Germany

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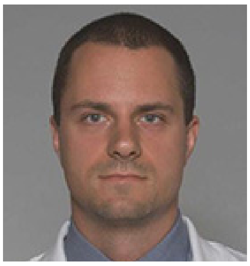

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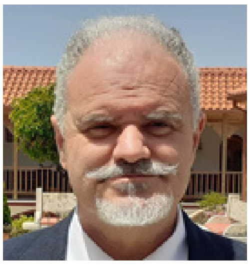

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Embracing Change, Sharing Knowledge

&

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16-19 June 2021

EMP News Summer 2021: 3rd ECMP Commercial Supplement

Commercial Supplement

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EMP News Summer 2021: 3rd ECMP

Commercial Supplement

This supplement to European Medical Physics News gathers together articles from companies which are Supporters and Exhibitors at ECMP and those which are EFOMP Company Members

Contents:

Photo: Mole Antonelliana, Turin – by David Lurie

EFOMP COMPANY MEMBER

Accuray: Lung Tumour Motion Has Met its MATCH with Synchrony® for Radixact®

ACCURAY

The winning score(s) for the AAPM MArkerless Lung Target Tracking CHallenge (MATCH), Part B, were accomplished with Accuray Synchrony® Lung Tracking™ with Respiratory Modeling™ product that directly tracks a lung tumour/target that exhibits respiratory motion, without any implanted fiducials. It is now available on the Radixact® device. While clinical validation has already been achieved with this product, this contest very effectively serves as an excellent open external scientific validation of Synchrony® tracking fidelity. In fact, the performance is even better than the reported RMS values would suggest, because of setup errors that would not be present in the dose profiles for all the Accuray submissions: setup errors are zeroed out in effect.

Clinical treatments using Synchrony® allow for greatly reduced margins, and no internal treatment volume (ITV) for motion is required. *Accuray Radixact Synchrony will track within a root-mean-squared (RMS) average error < 1 mm* in proper operation and with a 1 mm or finer planning computed tomography (CT) scan. Most margins will be dominated by factors other than motion by using Synchrony. Initial sites are finding a decrease in their PTV size by about 30%, allowing for a boosted tumour dose and increased tumour control. For all core dosimetric phantom tests, 100% of points passed the gamma metric at 3%/3mm for respiratory. For these same core motion respiratory tests, the maximum RMS tracking error was only 0.39mm with setup errors zeroed out. The early clinical use is confirming all these results as well (Chen et al., 2020).

Synchrony very literally *synchronizes the beam position and width per voxel with adaptive beam steering for all times during the treatment*, leaving only a small residual blur related to spatial resolution and geometric constraints. Respiratory motion dose errors (interplay and blurring) are nearly eliminated by actively tracking the target and then steering the beam such that it retains the same strength to a *modelled position*, synchronized to the tumour location in time and position (respiratory motion mode). Synchrony treats to the modelled position: the result of sophisticated software (Schnarr et al., 2018) that correlates the found tumour position with the motion of an external surrogate sampled every 10 msec and adapts in real time: fitting in time and so effectively eliminating latency.

There need be no increase in treatment time with Synchrony. Viewing dose as a time integral, Synchrony changes only the integrand (effective dose rate seen by the voxel), but not the time limits (treatment time). Gating does the very opposite in fact! See Figure 1 for an example phantom Lung Tracking QA treatment with dosimetry and tracking analysis. Phase shifts between the chest surface movements and lung tumour movements were explored in a collaborators' work (Ferris et al., 2020). It is an honour to be a part of this product's development.

References:

Chen GP, Tai A, Keiper TD, Lim S, Li XA. "Technical Note: Comprehensive performance tests of the first clinical real-time motion tracking and compensation system using MLC and jaws" [published online ahead of print, 2020 Apr 11]. Med Phys. 2020;10.1002/mp.14171. doi:10.1002/mp.14171

Schnarr E, Beneke M, Casey D, et al. "Feasibility of real-time motion management with helical tomotherapy" Med Phys. 2018;45(4):1329-1337. doi:10.1002/mp.12791

Ferris WS, Kissick MW, Bayouth JE, Culberson WS, Smilowitz JB. "Evaluation of radixact motion synchrony for 3D respiratory motion: Modeling accuracy and dosimetric fidelity" J Appl Clin Med Phys. 2020 Sep;21(9):96-106. doi: 10.1002/acm2.12978. Epub 2020 Jul 21. PMID: 32691973; PMCID: PMC7497925.

RESEARCH IN MEDICAL PHYSICS

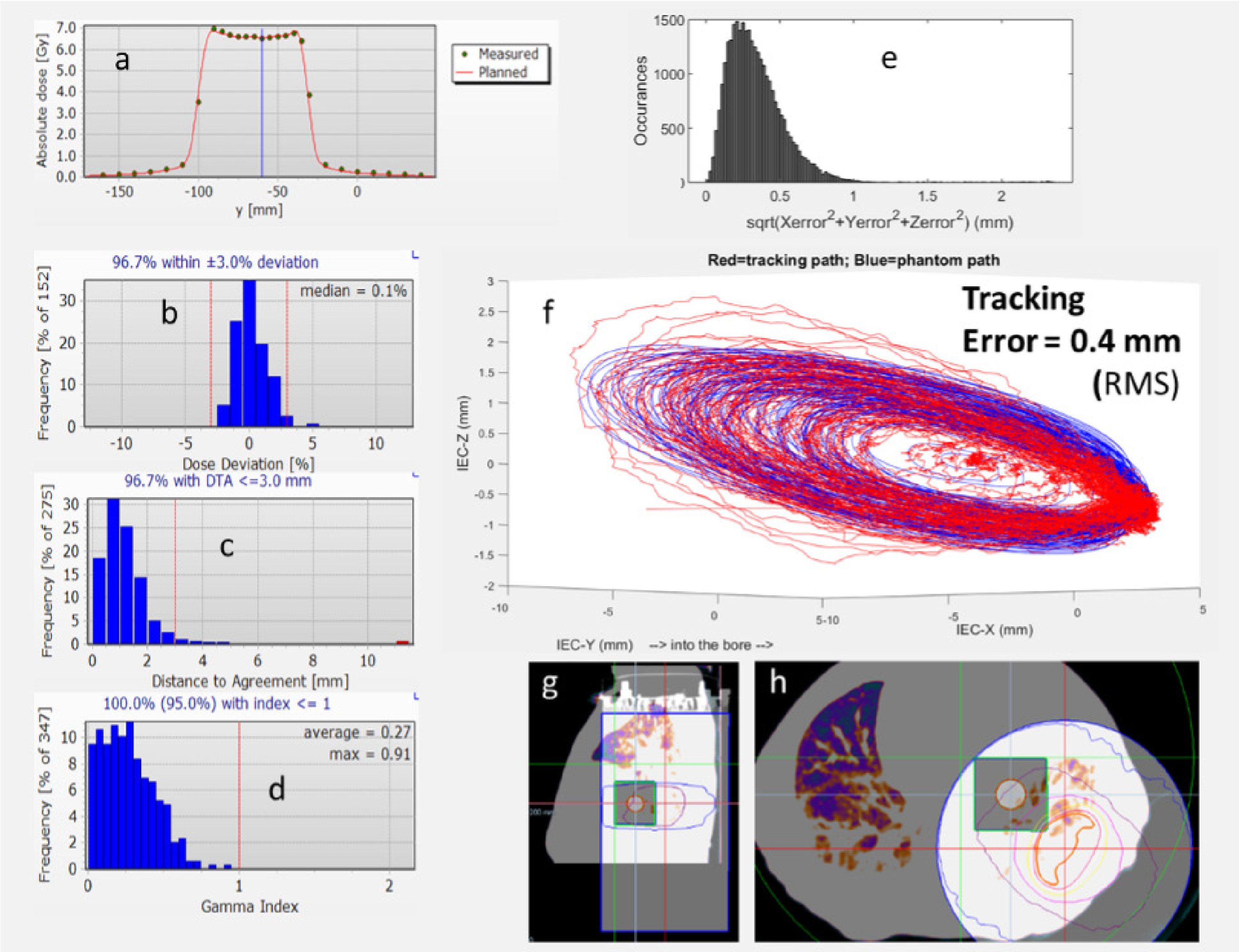


Figure 1: Example Synchrony® Lung TrackingTM with Respiratory ModelingTM respiratory delivery (patient_QA style) in the ScandiDos Phantom+/HexamotionQA phantom, tracking a custom lung cube far off axis in a modified ScandiDos Phantom+/HexaMotion® to track the motion. The lung cube is a 25 mm diameter sphere of 75HU material inside lung equivalent material cube. The CT scan had 1mm slices. (a) The IEC-Y (into bore) profile of measured (while moving as shown) dose points versus the planned dose profile. (b) measured dose deviation in the PTV. (c) Distance-to-agreement histogram for use in gamma. (d) The gamma histogram showing average and max values. (e) A histogram of the 3D position offsets from the planned position for each time step of the motion stage. (f) A 3D plot of the actual motion (blue) and the tracked motion (red). Note that the trace started over and spirals-out from its mean position as it starts. (g) is the sagittal and (h) is the axial view of the planned dose on the Phantom+ with the patient plan overlaid. The dose contours are also overlaid. Note the intersection of the green lines indicating isocenter; the target is therefore far off-axis.

Michael Kissick, Ph.D. has been an R&D Physicist for Accuray, Inc. for four years. He was originally a Nuclear Engineer and received a Ph.D. in 1993 in Plasma Physics. He then transitioned in 2000 to work with Rock Mackie and others until leaving academia to join the Radixact excitement.

ECMP GOLD SUPPORTER EFOMP COMPANY MEMBER

GE Healthcare: The clinical benefits of AIR™ Recon DL for MR image reconstruction

The advantages of MR as a medical imaging modality are well documented. Unfortunately, long imaging times and a lack of high spatial resolution remain as common clinical complaints and represent a major focus of present-day technical development activities.

To this end, the MR industry has addressed these needs with innovations such as parallel imaging, compressed sensing and simultaneous multi-slice for scan time acceleration.

Artificial intelligence, particularly deep-learning (DL) techniques such as AIR™ Recon DL, have recently been introduced to improve image quality (SNR and sharpness) as well as enable scan time reductions.

In MR imaging, raw data is collected in the form of so-called k-space, which represents the Fourier transform of the object being imaged. Due to the finite amount of k-space that is collected in MR imaging, certain artifacts result, such as Gibbs ringing, which is also known as a truncation artifact, and occur irrespective of the pulse sequence. Gibbs ringing manifests as duplication or ringing of sharp edge structures, like cerebrospinal fluid (CSF). To reduce Gibbs ringing artifacts, raw data is routinely filtered or apodized, effectively suppressing the peripheral regions and consequently attenuating high-resolution structures. However, suppression of Gibbs ringing through raw data filtering comes at a cost in image sharpness or spatial resolution. This delicate balance of Gibbs ringing suppression and spatial resolution is a well-known tradeoff in MR imaging.

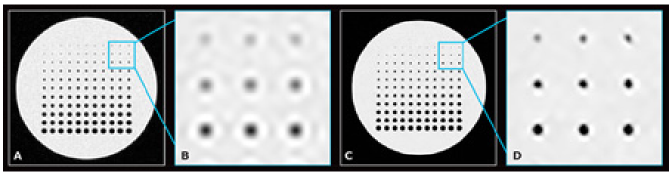


Figure 1. AIR™ Recon DL Intelligent Ringing Suppression for sharper images as demonstrated in an imaging phantom. (A) Conventional image reconstruction with apodization still results in significant Gibbs ringing. (B) Magnified A showing ringing and a loss of fine detail in the circular structures. (C) The same raw data as reconstructed using AIR™ Recon DL shows elimination of Gibbs ringing artifacts and (D) considerably sharper images. Note that the AIR™ Recon DL images also show the added benefit of noise reduction, however, this is considered unrelated to the improved sharpness of the images

One image quality metric that is often used to describe image quality is SNR. In MR, there are multiple sources of noise, such as thermal and electrical noise, which impacts the raw data that is collected. Noise in raw data translates into noise in the final image. The typical approach to improving SNR is to perform multiple averaging, which comes at the expense of prolonged scan time, or to increase the voxel volume at the expense of lower spatial resolution. Other hardware-related solutions to improve SNR include using a higher field strength, quality surface coils and low-noise receiver components, which add to overall system cost.

In 2020, GE Healthcare introduced AIR™ Recon DL, an algorithm that is embedded in the MR image reconstruction pipeline, where a neural network model is applied to remove noise and Gibbs ringing artifacts prior to final image formation. The network employs a cascade of over 100,000 unique pattern recognitions for noise and low resolution to reconstruct only the ideal object image.

AIR™ Recon DL performs two separate functions within the MR image reconstruction pipeline: ringing suppression and SNR improvement. These provide for clinical benefits such as scan time reduction, sharper images, greater tolerance of protocol variations and images that are easier and faster to read.

Based on a phantom study for equivalent spatial resolution, it is estimated that the AIR™ Recon DL in-plane voxel dimension can be approximately 1.4 times larger than that of the conventional image. This 1.4 factor is consistent with an independent study that found a factor of 1.6, based on edge gradient analysis. Results from this phantom study suggest that a lower in-plane matrix setting can be used with AIR™ Recon DL to obtain equivalent spatial resolution and image sharpness as a conventional image, independent of the SNR improvement.

AIR™ Recon DL provides a solution to the tradeoff with SNR, spatial resolution and scan time. To begin, SNR is usually thought of as an output metric of the image, which depends on various input protocol settings of the MR scan such as voxel volume (e.g., spatial resolution) and number of averages (e.g., scan time).

SNR is directly dependent on voxel volume. Voxel volume is typically used to characterize the prescribed spatial resolution. It is generally intuitive to most MR users that the larger the signal-bearing voxel volume, the greater the SNR and that this dependence is linear, i.e., if the voxel volume doubles then the SNR doubles.

In MR imaging, the most common way to increase SNR is to acquire additional signal averages or excitations, effectively collecting more raw data. Unfortunately, due to the nature of MR noise statistics, a doubling of the number of excitations (NEX) only results in a square root 2 increase in the resultant SNR. The well-known relationship is that SNR varies as the square root of the total scan time.

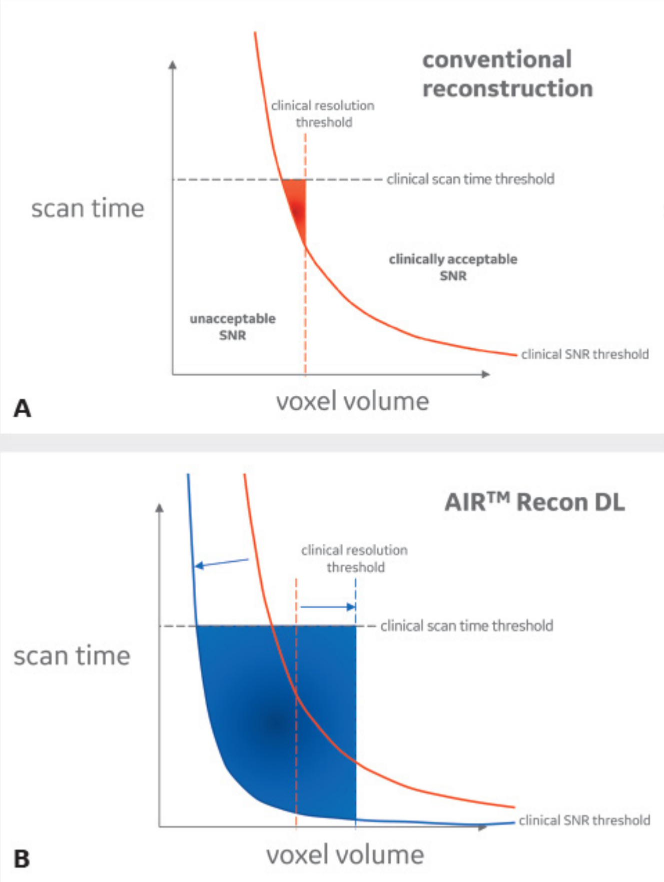


Figure 2. Expanded clinical protocol space with AIR™ Recon DL. (A) Conventional reconstruction with the clinically acceptable SNR contour, as indicated in red, the only protocol combinations of voxel volume and scan time that are simultaneously clinically acceptable for SNR, scan time and spatial resolution is the triangular area in red. (B) An expanded protocol space with AIR™ Recon DL reconstruction showing the clinically acceptable SNR contour to be shifted lower and the clinically acceptable resolution threshold is further to the right, compared to conventional reconstruction in (A, red solid and dotted lines). The area in blue represents more protocol combinations of voxel volumes and scan times that are clinically acceptable for SNR, scan time and spatial resolution with AIR™ Recon DL.

Acceptable clinical protocols are those that simultaneously meet three criteria: SNR, spatial resolution and scan time. Figure 2A is an example of conventional reconstruction. Given a clinically acceptable SNR level, as indicated by the red contour line, any protocol with a larger voxel volume or longer scan time will result in higher SNR. However, the acceptable clinical protocol is also bounded by the clinical spatial resolution threshold (vertical dotted line) and clinical scan time threshold (horizontal dotted line), leaving the only clinical acceptable protocols as being those in the red triangular shaped region in Figure 2A.

We can redraw the protocol space for AIR™ Recon DL to see how the SNR gain and improved image sharpness manifest in the protocol space. As shown in Figure 2B, the SNR contour with AIR™ Recon DL is shifted lower for scan time and voxel volume due to the SNR advantage over conventional reconstruction. To clarify, the red contour in Figure 2A and the blue contour in Figure 2B represent the same clinically acceptable SNR, however, AIR™ Recon DL delivers this with shorter scan times and smaller voxel volumes. Also note the positioning of the clinical resolution threshold (vertical dotted line) as being further to the right on Figure 2B compared to Figure 2A. This reflects AIR™ Recon DL's Intelligent Ringing Suppression that can deliver equivalently sharp images with larger voxel volumes.

Users have the freedom to select their own level of SNR improvement through a user interface that provides a low, medium or high setting.

Of the thousands of cases collected with both conventional and AIR™ Recon DL reconstructions, no pathologies were reported to have been missed compared to the conventional reconstructed images. In addition, no instances were identified where structures were hallucinated with AIR™ Recon DL. AIR™ Recon DL is compatible with all anatomies.

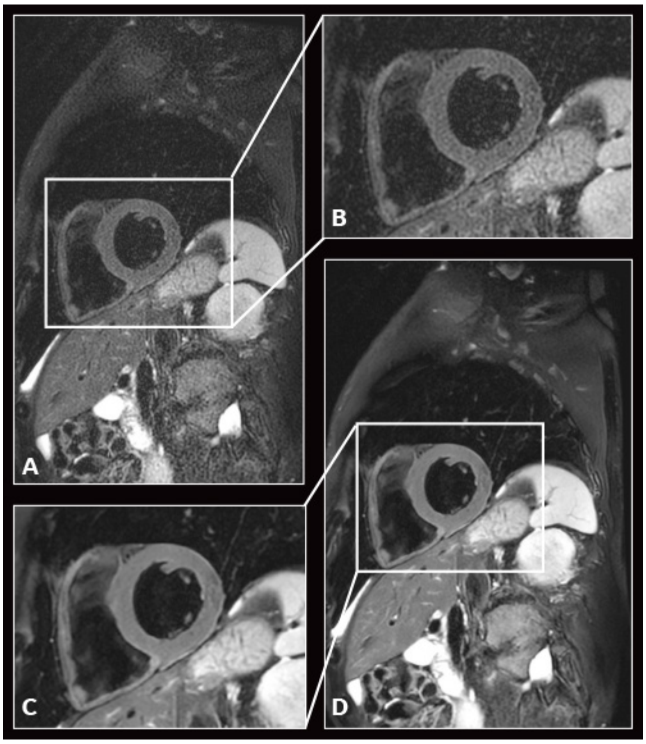


Figure 3. SNR improvement with AIR™ Recon DL. Shown is a short axis T2 Double IR black-blood FatSat breath-hold scan, 1.3 × 1.4 × 6 mm, 2:13 min. scan time with 11 sec. breath hold. (A, B) Conventional image reconstruction and (C, D) AIR™ Recon DL high setting of the same raw data showing considerable SNR improvement.

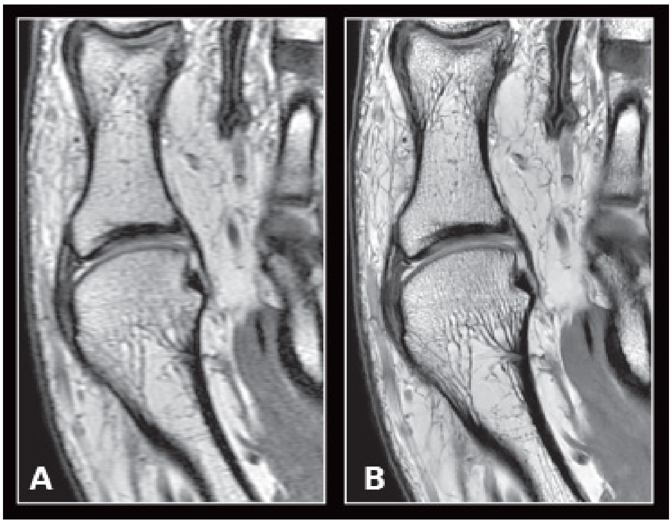


Figure 4. Sharper images with AIR™ Recon DL. Shown is a coronal FSE PDw, 0.3 × 0.3 × 1.0 mm of the first metatarsal. (A) Conventional image reconstruction and (B) AIR™ Recon DL high setting of the same raw data (same matrix and scan time) showing sharper trabecular structure.

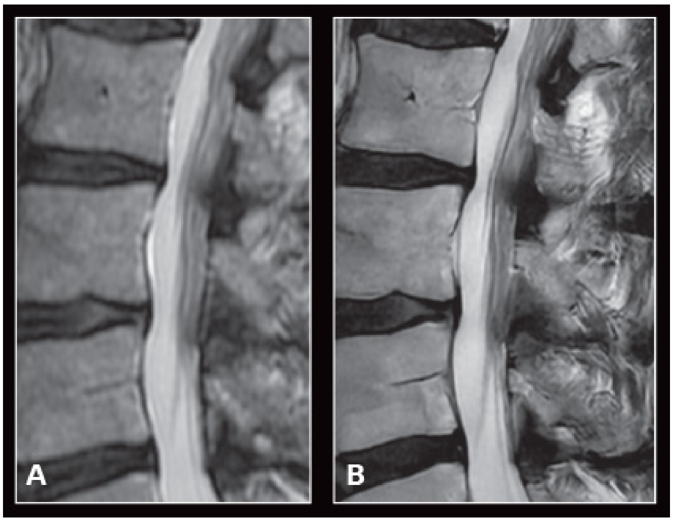


Figure 5. Lumbar spine exam demonstrating (A) conventional reconstructed image, 0.9 × 1.3 × 3 mm, BW 32.2 kHz, NEX 2, 2:47 min. and (B) AIR™ Recon DL reconstructed image, 0.7 × 0.9 × 3 mm, BW 41.7 kHz, NEX 1, 1:16 min.

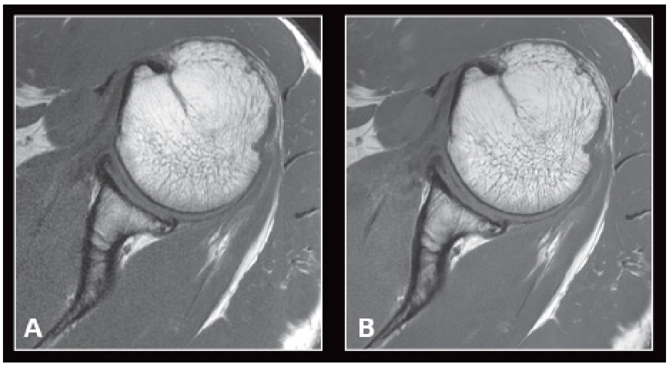


Figure 6. Shoulder exam demonstrating a 46 percent improvement in resolution and a 36 percent reduction in scan time with AIR™ Recon DL. (A) Conventional reconstructed image, 0.4 × 0.6 × 3 mm, BW 41.7 kHz, NEX 1, 2:14 min. and (B) AIR™ Recon DL reconstructed image, 0.3 × 0.5 × 3 mm, BW 62.5 kHz, NEX 1, 1:33 min.

Rob Peters completed his M.Sc and Ph.D degrees in MR imaging technology from the University of Toronto and has been with GE Healthcare MR for over 20 years. As a Global MR Product Marketing Director, Rob is responsible for neuro and MSK applications where he leverages his technical background and customer need experience to define and promote GE's MR imaging portfolio.

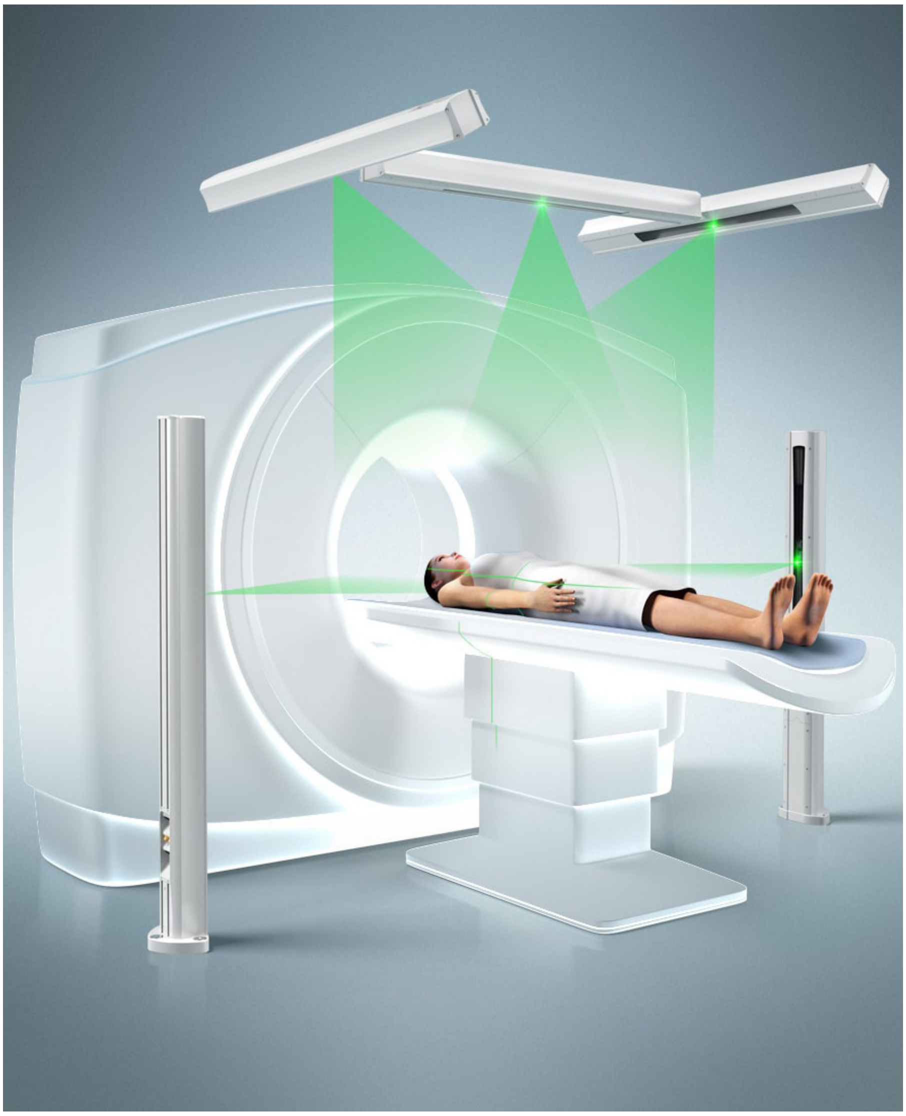
Steve Lawson has experience as an MRI Technologist spanning over 23 years, including research MR scanning with the National Institute of Health (NIH) and the Medical College of Wisconsin. As the Global Clinical Marketing Manager he leads the product demonstrations highlighting the latest features and enhancements for customer visits as well as the ISMRM and RSNA. He also is a key contributor and creative director for SIGNA™ Pulse magazine and writes and produces the "MR CrossTalk" video series.

Heide Harris started her GE career 20 years ago as the MR Clinical Education Applications specialist, building on her experience as an MR technologist. During a brief hiatus from GE, she led the University of Chicago Hospital MR department as the modality manager supporting both clinical and research scanning. Upon returning back to GE, Heide infused her MR experience in various roles including Clinical Product Development, Global MR Clinical Marketing Training Manager, and to her current role of Global MR Product Marketing Director focusing on Body and Cardiac clinical solutions.

ECMP SILVER SUPPORTER EFOMP COMPANY MEMBER

LAP: System integration and intelligence are marking the future in patient positioning

Hypofractionated radiation therapy is on the rise. While receiving a higher dose per fraction in fewer sessions makes not only sense for an improved patient experience but also for the treatment facility in terms of reduced costs of caring and increased patient throughput, it makes precision even more important. Protecting patients against ionizing radiation to healthy tissue is essential. To achieve the goal of concentrating the radiation directly on the tumour, patient positioning needs to be exact and reproducible for every treatment session.



Hereby lasers have one important task: to support the patient positioning and alignment as precise as possible in the most time saving way. To save precious linac time the setup and preparation of patient positioning tasks can already be done in the CT room.

Starting in the treatment chain the first step is the imaging of the patient. After positioning and immobilizing the patient, a CT image is created, followed by an optional step of virtual simulation. The coordinates of the target point are identified, and the patient gets marked. To get higher soft tissue contrast, MR imaging might follow for certain cancer types (e.g. brain). Here, the patient must be positioned and oriented identically to the CT imaging to match the image data from CT and MR. Once more precision and accuracy play a major role as does safety. By the way, LAP's DORADOnova MR3T and APOLLO MR systems are the only laser systems in MR environment which are FDA 510(k) cleared.

The treatment itself will be performed at the LINAC after the treatment planning. Here again the patient must be positioned, immobilized and aligned according to the target point followed by the irradiation. It is important that the immobilization from the CT is replicable multiple times at the LINAC for each fraction of the treatment.

To summarize these steps: There are different coordinate systems in the treatment chain: the coordinate system of the CT and MR, the coordinate system of the patient and the coordinate system of the treatment machine. While planning and treating patients, these coordinate systems need to be congruent. LAP offers an independent and reliable coordinate system projected with laser for every step. Lasers at CT, MR and LINAC help to match these coordinate systems so that the treatment is successful and time efficient. The lasers are also used as a machine independent reference to regularly perform QA tasks.

Torsten Hartmann is Director Product Management Business Unit Healthcare at LAP GmbH Laser Applikationen. He has more than 20 years healthcare experience, having held positions in software development, project and department leads. He joined LAP in 2006 and has since driven products in radiotherapy.

All workflows in CT and MR are perfectly supported by LAP's DORADO and DORADOnova laser systems. Together with the CARINAnav control system which offers two standard interfaces for data exchange and one interface for direct laser steering integrated in syngo.via RT Image Suite of Siemens Healthineers. LAP systems are the only laser systems that offer this significant advantage of system integration. This is also where we see a strong potential in the future: integrating our systems with dedicated interfaces in the RT environment to reduce system borders and minimize use errors. Developing open interfaces between lasers and imaging and radiotherapy systems from multiple OEMs will make patient positioning and alignment task even faster and more convenient for the patient. All while keeping the usability simple and easy to handle. Furthermore "built in intelligence" could be useful in tracking geometric deformations in patient anatomy from treatment session to treatment session and adjust accordingly. These and further developments are shaping the future of patient positioning.

ECMP GOLD SUPPORTER

Mevion – Pioneering FLASH Delivery Innovations

FLASH Therapy*, a non-invasive, ultra-high dose rate technique delivered in less than one second, may dramatically improve the cancer-fighting benefits of therapeutic radiation by shortening treatment courses and lessening side effects

MEVION medical systems

First Demonstration of FLASH Effect at Bragg Peak

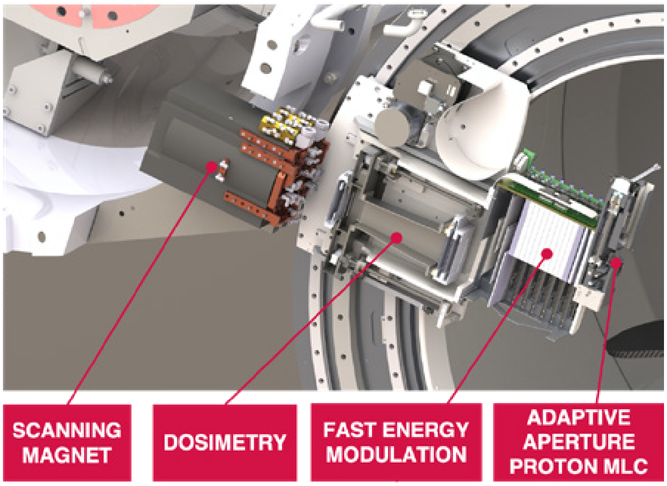
In October 2020, Mevion presented the first pre-clinical results of its research, demonstrating the FLASH effect using a commercial MEVION S250i proton accelerator. The study results showed a clear signal in improved survival curves for FLASH irradiated mice. This study is also the first demonstration of the FLASH effect at the Bragg Peak, indicating the promise of combining Bragg peak dose conformality and FLASH normal tissue sparing in one delivery system.

Mevion's study was modeled after a benchmark experiment performed with electrons [1] by Stanford University and aimed to increase the survivability of healthy mice when delivering doses at FLASH rates, which are lethal when delivered at conventional dose rates.

In the experiment, fifty healthy, non-tumour-bearing mice received abdominal irradiation within the range of 10 - 19 Gy. Thirty of the mice received the dose at FLASH dose rate at 100Gy/s, and twenty of the mice received the irradiation at conventional dose rate at 0.1 Gy/s. The results showed a clear separation of survivability between the two groups, indicating better than normal tissue sparing with FLASH dose rates delivered at the Bragg Peak.

MEVION S250i - Ideal for FLASH Delivery

Mevion proton accelerators are inherently able to achieve ultra-high dose rates and delivery speeds necessary for a successful FLASH effect thanks to its unique Direct Beam Delivery (DBD) system architecture.



Mevion Direct Beam Delivery is ideal for FLASH delivery

The DBD system, a standard feature in the MEVION S250i, is ideal for delivering high-quality, efficient proton treatments needed for future FLASH clinical deliveries. The scanning magnet is capable of 3-millisecond spot switching, the energy modulation system can switch as fast as 50-milliseconds, and both are engineered with intrinsic capability for further reductions in delivery time. Most importantly, Mevion's DBD features a highly efficient beamline where transmission efficiency does not drop below 70% for energies as low as 50 MeV. This design, exclusive to Mevion, enables a Bragg Peak FLASH delivery at all treatment depths at ultra-high dose rates.

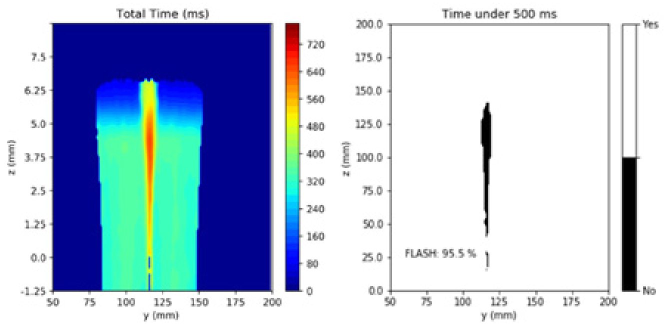
Previous proton FLASH research has been limited by the beamline design of other proton machines that rely on conventional energy selection systems (ESS). Beamline transmission efficiencies are very low at low energy (often less than 1% at energies below 70 MeV), making it difficult to achieve a high dose rate at low energies. Experimental treatments are therefore delivered with high-energy "shoot-through" beams, resulting in uniform depth-dose distributions and abandoning the conformality advantages of the proton Bragg peak.

The core strengths of DBD allow Mevion systems to deliver both conformality and FLASH dose sparing, which are critical for clinical FLASH proton therapy treatments.

FLASH Delivery Technique for Large Volumes

Another area of Mevion's active research explores how best to deliver FLASH dose rate to a larger volume of several hundred cubic centimeters or more, a common irradiation volume for typical cancer patients.

Mevion has approached this research with Monte Carlo modeling and is pursuing additional machine development to demonstrate that adjacent intensity modulated small volumes can be delivered at FLASH dose rates separately. Those individual small volumes can then be combined to create a single large volume [2], that will benefit from FLASH normal tissue sparing. This technique offers the possibility to combine both IMPT and FLASH in one delivery system.

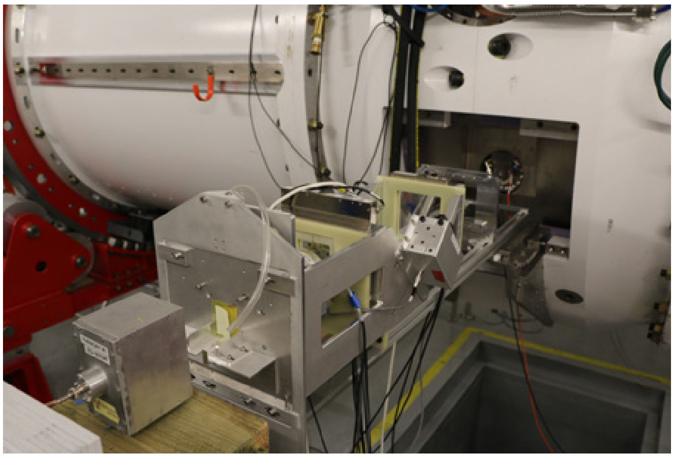


FLASH Research Accessory Enabling Easy Switch Between FLASH Research and Clinical Treatment Mode

Built for power and speed, Mevion proton systems were designed with the future in mind. MEVION S250i accelerators can be easily switched from clinical use to FLASH Development Mode to deliver the high dose rates needed for the Bragg Peak's FLASH effect at any energy, making it simpler for centers to study this breakthrough technology's potential clinical application.

The nature of the MEVION S250i synchrocyclotron allows a very high instantaneous dose rate within a pulse. Since 2019, Mevion has collaborated with scientists from Siteman Cancer Center at Barnes Jewish Hospital and Washington University in St. Louis on a series of tests on a MEVION S250i production system. The team successfully delivered over 200Gy/s dose rate and published a joint research paper [3] in Medical Physics in 2020. This active collaboration is focusing on dose rate, dosimetry and calibration.

Mevion has developed a set of FLASH research accessory, including dosimetry units, apertures, ridge filters, and absorbers, which can flexibly shape, control, and monitor appropriate fields for small animal studies. The accessory, currently in proof-of-concept testing, will be available to current MEVION S250i users, and will allow a fast and easy switch from clinical mode to FLASH research mode. The system dosimetry is engineered to function at both conventional and FLASH dose rates corresponding to the large dynamic range capability of 1000.



Mevion FLASH research accessory prototype

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ECMP EXHIBITOR   EFOMP COMPANY MEMBER

The PTW Calibration Lab: Precision and reliability, with almost 100 years of experience

PTW Freiburg operates one of the longest established and largest calibration laboratories worldwide within the field of ionizing radiation – it was founded almost 100 years ago. Within its near century of existence, the company has gathered vast amounts of experience with regard to the calibration of radiation measuring devices: More than 12,000 calibrations are carried out in the PTW Calibration Lab every year. Such calibrations are necessary because only correctly calibrated equipment can be operated with the assurance that, for example in radiation oncology, the proper dose is delivered to the patient.

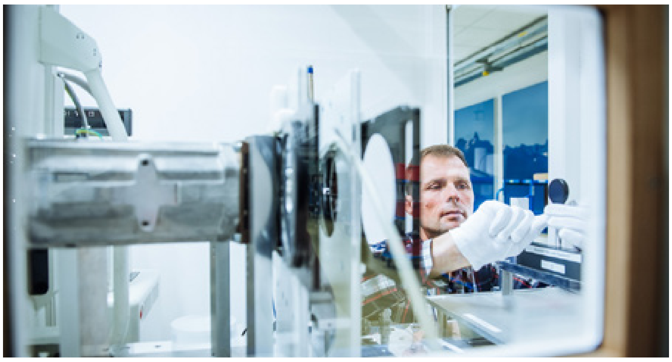
PTW THE DOSIMETRY COMPANY

PTW Calibration Lab – substantial infrastructure for a wide range of calibration needs

The PTW laboratory routinely calibrates hundreds of different dosimeters and devices from numerous sources. Its customers are mostly hospitals, but also include the irradiation equipment manufacturers themselves. Calibrations are performed mainly on detectors used in radiotherapy and diagnostic radiology, also to a lesser extent on equipment used in radiation protection, for example reference standard instruments. In addition, detectors for non-invasive measurements of high voltage in diagnostic radiology and mammography are calibrated here. The PTW lab shows no preferences to equipment from specific manufacturers and generally accepts any measuring instrument that can be calibrated with the available equipment.

The calibrations performed at PTW are a success story which goes back almost 100 years: Only a short time after the company was founded in 1922 it already had its own calibration laboratory, which then was one of the first calibration laboratories in Germany to be accredited by The German National Accreditation Body (today: Deutsche Akkreditierungsstelle GmbH (DAkkS), formerly: Deutscher Kalibrierdienst). As an accredited calibration laboratory, the PTW lab carries out calibrations traceable to the Physikalisch-Technische Bundesanstalt (PTB), which is the National Metrology Institute of Germany. Moreover, the lab is subject to regular audits, which are conducted to ensure its adherence to standard calibration procedures and documented test methods, the availability of all equipment required for the calibrations performed, as well as the competence of the staff who perform calibrations. Calibrations conducted by the PTW Secondary Standard Dosimetry

Laboratory (SSDL) are not only recognized in Germany, but worldwide: In 1979 it was accredited to the international laboratory standard EN ISO/IEC 17025, and in 2000 it became a member of the IAEA/WHO SSDL Network.



Eight x-ray calibration benches to cover the full range of kV radiation qualities

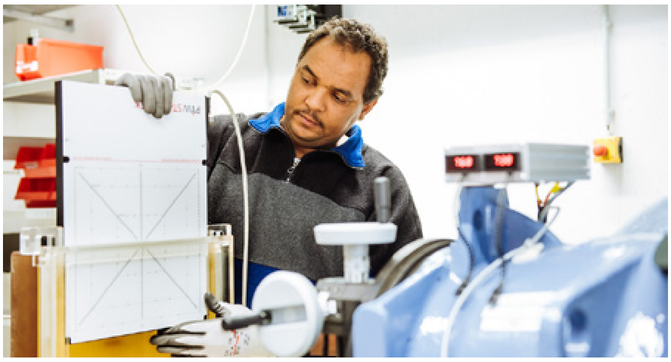
Regular calibrations are in the patients' best interests

If dosimeters are not calibrated regularly, the user runs the risk that they will not function as designed. In a worst-case scenario this can cause harm to the patient, and thus the predominantly clinically based users carry a huge responsibility. Legal regulations are not in place everywhere, but many countries and medical physics societies have published their own codes of practice and manufacturers also provide recommendations: A general rule is that every device should be calibrated once every one to two years. PTW recommends that its own equipment be calibrated once every two years. Every instrument manufactured by PTW is delivered to the customer in a calibrated state in order to enable the user to carry out highly precise measurements.

If radiation measuring equipment is not recalibrated regularly, small but significant deviations within the measurements can remain undetected. The detectors and instruments are very stable and can generally be used for a long time, if handled professionally by the operator. If a detector is defective to the extent that there are large deviations, this becomes immediately apparent to the user. However, small deviations of e.g., below five percent, may go unnoticed in the daily hustle and bustle in the clinic. Regular calibrations allow errors to be discovered and corrected.

Calibrations can take many hours

The time required to calibrate a measuring device varies. One of the most important calibrations is that of a reference chamber for absorbed dose to water in radiotherapy. This is done using a water phantom and takes at least 15 minutes. In contrast, for example, the calibration of a chamber used in diagnostic radiology, especially when including mammography, takes a much longer time: To complete such a calibration, up to 10 RAD/FLU measurements are taken at different radiation qualities and up to 16 further MAM measurements may be done, which can take several hours.



One of two Cobalt calibration benches for calibration and quality control tests of ionization chambers, detectors and detector arrays

Every year there are approximately 12,000 calibrations carried out in the PTW Calibration Lab, and for these 12 different calibration benches are used: Two Cobalt, two Caesium and eight x-ray calibration benches to cover the full range of kV radiation qualities. This substantial infrastructure makes the PTW lab one of the best equipped dosimetry laboratories in the world. Traceability to the primary lab at PTB is ensured by an extensive range of transfer standard instruments. Calibrations are performed by specially qualified experts with years of experience, including physicists and radiation protection experts. The software used for most calibrations has been developed in-house to meet the requirements of a busy dosimetry laboratory.

The quality of a calibration laboratory is difficult to measure or quantify. However, multiple successful accreditations in accordance with the required standards, along with consistently positive audits are telling indications of high quality. An additional decisive factor is that the lab has many years of experience and qualified staff. This is the case with PTW, which is one of the reasons why the audit results are unanimously positive and why comparison measurements with PTB or IAEA are always successful, down to the per Mille range, i.e. well within the combined uncertainty.

PTW shares its extensive know-how

The PTW Calibration Lab is making a valuable contribution to education and training: In recent years medical physicists from other calibration laboratories have been trained at PTW, some at the request of IAEA. Furthermore, PTW takes an active part in equipping calibration laboratories worldwide, thus helping reliable calibrations to be made locally, which is contributing to patient safety on a wider scale.

For further information about PTW's Calibration Lab, visit: https://www.ptwlab.com.

Christian Pychlau is a Managing Partner of PTW. He is the third generation of his family to be a leader of the world's most successful dosimetry company, which was originally founded by his grandfather Herbert Pychlau in the 1920s.

EFOMP COMPANY MEMBER

RTI Group: X-ray leakage and scatter measurements

For 40 years, RTI has produced solutions for quality control and quality assurance for X-ray

RTI was the first company that produced a non-invasive kV meter for X-ray. Today, our multimeters measure all interesting parameters - in one exposure - in the primary beam, to make sure that the right output comes out from the X-ray system. However, not only measurements in the primary beam should be performed. Leakage radiation from the X-ray tube and scattered radiation in the X-ray room are parameters that should be tested to minimize the risk of unnecessary exposure of patients and staff at hospitals.

Leakage

An X-ray tube should be well shielded, but some X-ray can still leak out from it. Measurements must be performed to make sure the leakage levels are low and that no malfunctions, like cracks in the shielding, have occurred. The IEC standard 60601-1-3 states that the leakage out of the tube should be less than 1 mGy in one hour and at a distance of one meter from the focus point. This must be measured using a detector with an active area of 100 cm^2, and it should be measured all around the X-ray tube with the collimation completely closed.

The IEC standard also states that no leakage should come out of the tube when no exposure is performed, like during warm-up of the cathode, etc. This test should be performed 5 cm from the tube surface, be less than 20 µGy in one hour, and measured using a detector with an active area of 10 cm2.

The set parameters during the tests depend on the X-ray unit, how much it is used in an average hour, what typical clinical parameters are, and local regulations in countries.

Scatter

When the primary X-ray beam hits a patient or a phantom, some of the beams will collide with electrons and scatter away in different directions (see Figure 1). This scatter may contribute as dose to the staff and visitors in the hospital. Factors that affect the scattered radiation are the size of the patient, field size, set X-ray parameters, and angle of the beam. Operation staff should be positioned far away from the tube and in a shielded position during exposure, when that is possible, or use lead aprons and other protections if they are in the room. X-ray rooms should be properly shielded to make sure that the scatter levels outside should be so low that it does not contribute too much to any once yearly dose limit. Due to this, the scattered radiation in different areas must be measured and evaluated.

To perform a scatter test, a water-equivalent phantom is normally put in the beam to represent a patient. The highest parameters that are clinically used should be set on the console, like the highest kilovolt and lowest inherent filtration. Measurements should be performed in areas of interest and measured with a very sensitive detector.

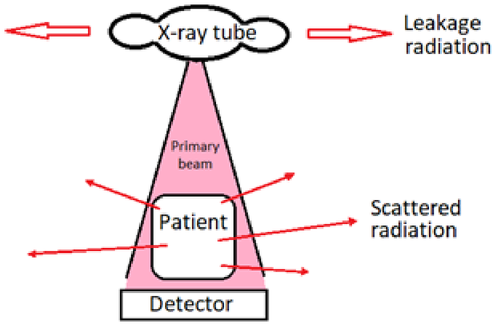


Figure 1: Scatter and leakage radiation.

RTI Scatter Probe

Due to the measurement requirements above, RTI has introduced the RTI Scatter Probe (see Figure 2). It is a standalone, solid-state detector with a unique detector design, which makes it possible to measure either with an active area of 100 cm^2 or 10 cm^2. This meets all the demands for leakage measurements. The detector is rugged and easy to carry. It can stand on its own, be used by hand, or be mounted on the included tripod or any other holder. The big detector area makes it very sensitive, which is a demand to measure on the low signals from scattered radiation. With its built-in energy compensation, the RTI Scatter Probe has flat energy dependence optimal to measure the wanted Air-Kerma Rate and ambient dose equivalent.

Figure 2: RTI Scatter Probe

The RTI Scatter Probe can trig by itself when hit by X-ray and can be put in the X-ray room during exposure. A button on the back of the RTI Scatter probe can be pushed to activate the detector and move it around areas to find small leakages. Diodes on the back will light up proportional to the amount of registered radiation. It can also give a sound proportional to the level of the radiation.

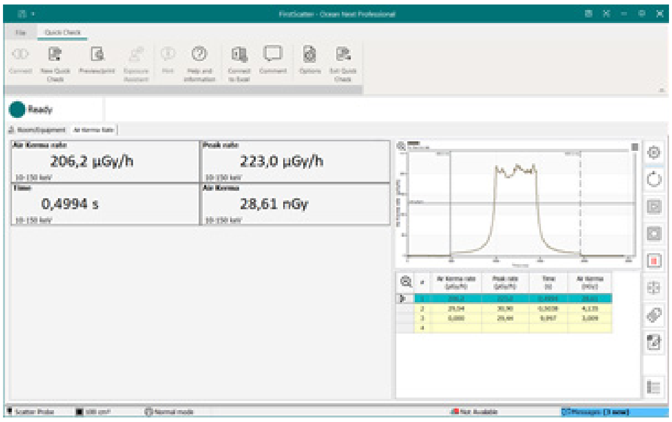


Figure 3: Measurement with the RTI Dose Probe in the Ocean Next™ software

The RTI Scatter Probe is connected to a tablet or a computer with a USB cable, and the data is presented and saved in the RTI Ocean Next™ software (see Figure 3). The same software can also be used with RTI´s other meters, to keep your measurements together, and for data to be presented in the same report.

Please contact RTI for more information or visit the RTI webpage for videos and more material.

Björn Cederquist Key Account Manager at RTI Group
Björn is a Sweden-based medical physicist. He started at RTI Group, in 2008, at the R&D department working with detector design. In 2009, he moved to the Sales department and is now working mainly with the company's key customers and sales and support in Japan and South Korea.

EFOMP COMPANY MEMBER

RTsafe: Customized Phantom Service – Build your own phantom to meet your specific needs

Complicated techniques require suitable solutions. Modern Radiotherapy is a complex and constantly changing technological environment consisted of many processes. Even minor changes in isolated points of this chain can upset the balance of the system. QA tools need to always adjust and be able to control all variables and parameters, however commercially available phantoms are mass production products that often fail to fit specific needs.

RTsafe offers a totally customer-centric phantom designing and manufacturing service, where the end-user becomes part of a multi-level design process defining the desired features, and in harmonization with the know-how of a specialized team, creates custom phantoms perfectly tailored to meet user's specific needs.

This way, the end user can have the exact solution required for any demanding case, describing their specific details. A dedicated Scientific and R&D team, by Medical Physicists and Engineers will come directly in contact with you to fulfil any bespoke demands. Having engagement of the customer with an ongoing discussion, the end user becomes a part of the design process.

The intended use of such solutions can vary. Starting from Periodic QA, Commission/Benchmarking to Scientific Projects and Academic Research. The same unique characteristics of RTsafe phantom exist including the MR/CT compatibility, realistic bone anatomy based on real patient CTs and multiple dosimetry options.

The process is simple. As a first step

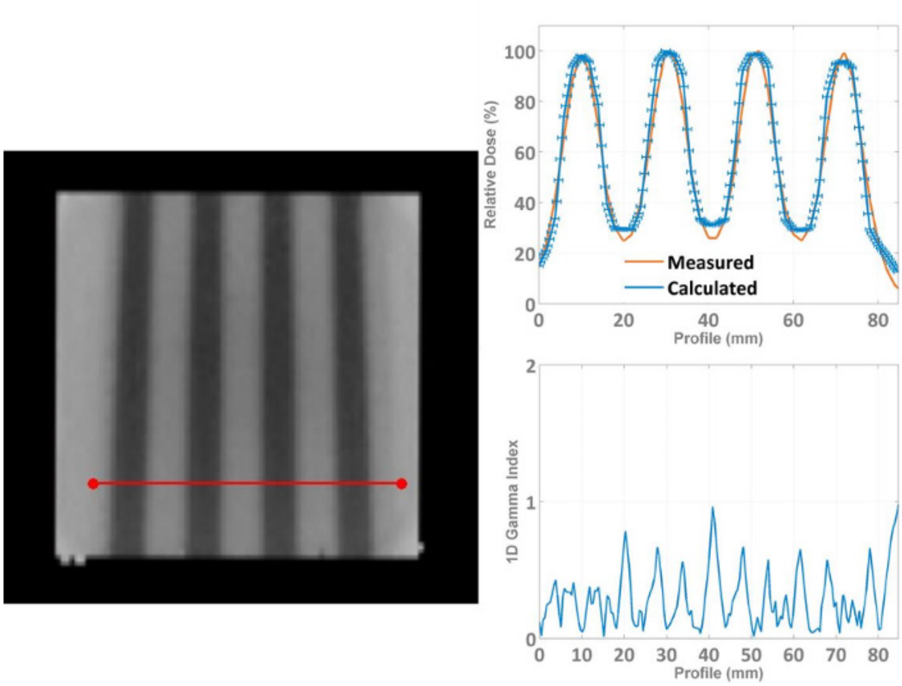


Figure 1: A part from the analysis from a GRID radiotherapy project. A specific cubic phantom was constructed for the needs of a research project. (left) Slice of the derived T2 maps of the irradiated cubic phantom. High dose regions correspond to darker areas. (right) 1D profile comparison between calculated (TPS) and measured (RTsafe) dose distributions at the location depicted by the red line. Error bars correspond to ± 1mm spatial uncertainty. 1D gamma index calculations are also given using passing criteria 5%/2mm.

the end user selects the desired body part (brain, head/neck or spine). Then at a second step, they choose the CT dataset. This could be either the RTsafe pre-owned CTs or the anonymized CTs of their specific real patient. The dosimetry tools can vary. From OSLs, TLDs, ICs to 2D Dosimetry-Films or even 3D Dosimetry- special containers and every possible combination between them. The orientation/area of the insert is also determined by the user. Dosimeters can be oriented at random points (central area sagittal/coronal). Regarding their position, they can be placed at areas designated by the end-user too. Extra Features, Metal implants / Tooth implants, Metal spheres, Thermal/Surface Imaging compatibility, and others can be also added. Some selected past projects of customization are cited below:

In Figure 1, a cubic phantom of specific dimensions selected by the end user was fabricated. This was for the purposes of a research project in GRID radiotherapy. An analytical dosimetric analysis report was provided by the RTsafe team.

In Figure 2, a customized spine phantom to accommodate titanium implants and ion chamber insert was built. This was for proton therapy QA for a real patient case. Ion chambers measurements at desired positions selected by the end user and titanium implants close to the chamber measurements to evaluate its effect were included.

In Figures 3-5, the already introduced IGRT/SGRT QA solution is presented. The combination of anthropomorphic anatomy and bone/soft tissue equivalency that these phantoms offer is a fact that makes them a must-have tool in every radiotherapy department - an essential tool for verifying the precision of localization and accuracy of dose delivery.

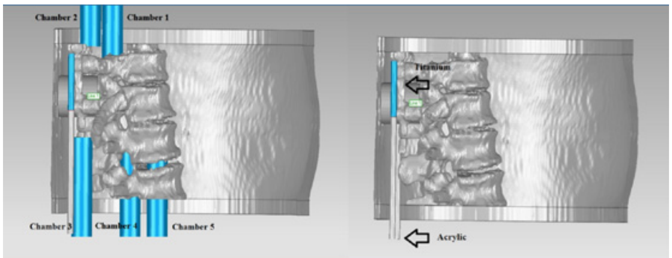


Figure 2: A customized spine phantom to accommodate titanium implants and ion chamber inserts was built for proton therapy QA.

Figure 3: Thermal to 3D camera calibration mapping using a customized head phantom for SGRT QA.

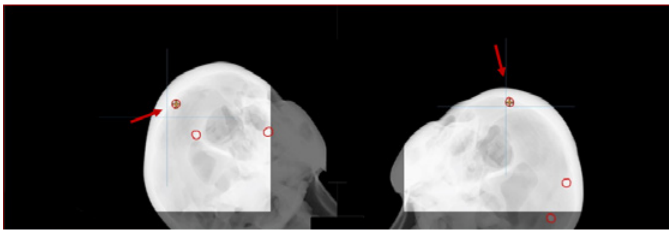


Figure 4: X ray verification. The predefined location of the reference points is also highlighted.

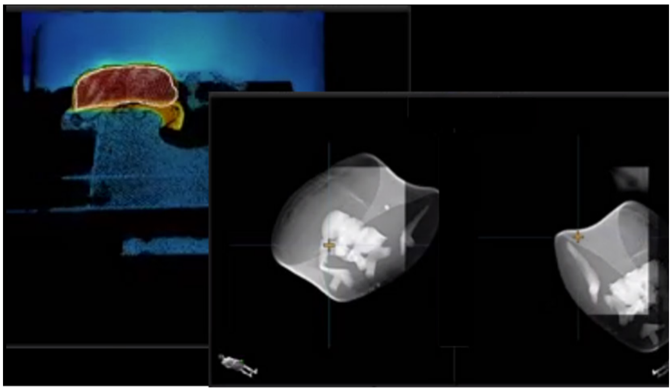


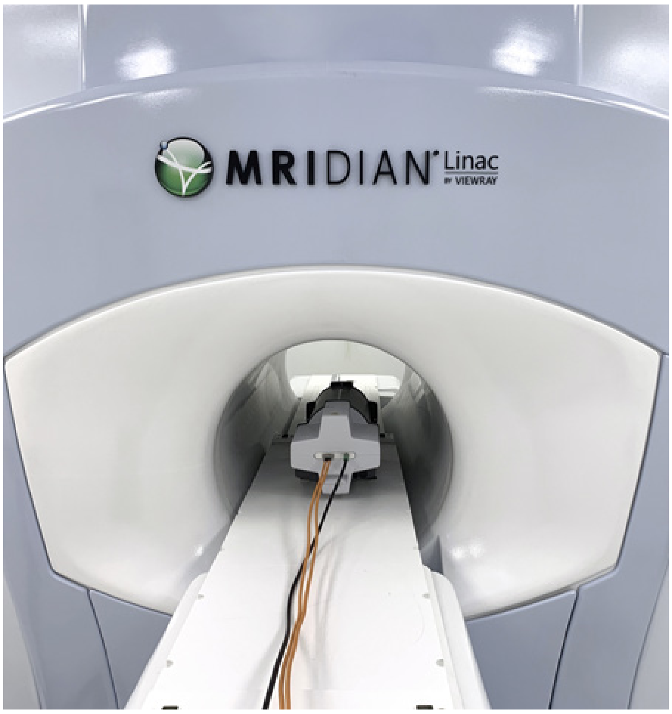
Figure 5: Thermal to 3D camera calibration mapping using a customized spine phantom for SGRT QA.

Georgios Kalaitzakis Product Manager
Georgios is responsible for the 3D digital design of the 3D printed phantom, the data analysis, the communication and the whole scientific support and guidance of the end user. He has a diploma in Electronic & Computer Engineering, where he focused on the estimation of pharmacokinetic parameters via dynamic contrast enhancement imaging in order to annotate the perfusion of the brain tumor. During his PhD in medical school in the University of Crete, he introduced advanced MRI biomarkers in CNS diseases.

EFOMP COMPANY MEMBER

Scandidos: Cutting-edge Technology at Herlev & Gentofte Hospital

Herlev & Gentofte Hospital has a multi-treatment machine department and is a long-time user of the Delta4 Phantoms. We were curious to hear about their QA work when doing treatments with the HALCYON, on-table adaptation with the ETHOS and their MRIDIAN. Beneath you can read the interview that was conducted with physicists Ulf Bjelkengren, Susan Biancardo and Grichar Valdes Santurio at Herlev & Gentofte Hospital in Denmark. You can find out more by following this link.



"We typically use the Delta4 Phantoms when implementing new techniques and treatment methods. We have been using the Delta4 Phantom since 2008 so we feel that we are very confident with the system. What has characterized this product is simplicity, flexibility, and stability. Also, ScandiDos has always had a great support team and we feel that the product, especially the software, has always been updated at a rapid pace.

QA ON TRUEBEAM, HALCYON AND MRIDIAN

In 2018 we made a large purchase of accelerators and at that time, it felt natural to upgrade the Delta4PT Phantom to the Delta4 Phantom+. We were happy to learn that the new Delta4 Phantom+ had been given every feature we felt was missing in the older model. It now benefits from measurement detectors in a different geometry, wireless communication, cable-free synchronization, and a much simpler calibration procedure. We have used the Delta4 Phantom+ for the commissioning of four Varian TRUEBEAMS as well as two Varian HALCYON and one Varian ETHOS. We also purchased the Delta4 Phantom+ MR, soon after its release, for commissioning on the ViewRay MRIDIAN. The Delta4 Software platform is utilized across all Delta4 products which is convenient for our staff since there is no learning curve when switching between models.

DELTA4 PHANTOM+ AND HALCYON

We got our first HALCYON machine in May 2019. The Delta4 Phantom+ was used to verify several treatment plans before the machine was released for clinical use. Since the beam data for HALCYON is pre-configured in the TPS and does not require any collection of measurements, all calculations could be made before the delivery of the machine. This meant that the commissioning, including dosimetry and Delta4 Phantom+ verification measurements, could be done in one day.

Suitable treatments on the HALCYON

Looking at the distribution of cancer sites in the clinic, about 30-40% are suitable for treatment on a HALCYON. Examples are pelvic tumours, head and neck, palliative treatments, and lung treatments not requiring motion management. The lack of motion management is one of the disadvantages of the HAL-

CYON. It would be great to be able to treat patients in DIBH with the fast gantry speed and fast CBCT acquisition. One breath-hold would be sufficient in most cases to complete a CBCT or a treatment field/arc. Further, with the ETHOS, we are able to make a new plan for the patient while the patient is on the couch. Currently, we are treating pelvic tumours on the ETHOS. Especially for bladder patients, there is a clear indication that the adaptive workflow has a clinical impact. As one of our physicians expressed herself: “No bladder patient is ever allowed to be treated on any other machine”.

Upgrade to ETHOS

Three months before upgrading one of our HALCYON machines to ETHOS we received an ETHOS emulator. This emulator simulates the complete workflow from prescription to treatment delivery. With CBCT’s from the HALCYON exported to the emulator, real adaptive simulations could be made on actual patient data. And since the ETHOS and HALCYON machine-wise are the same, the treatment plans from the emulator could be exported to the HALCYON and the treatment plans measured with the Delta4 Phantom+.

Evaluation of measurements

When we evaluate measurements, we primarily use the gamma evaluation with a local gamma and 3%/2mm. A result is a clear pass if the passing rate is above 95%. We do not solely rely on the gamma, evaluating the profiles is also a good tool to get a feeling for the measurement. For some highly modulated plans, we have also exported the measurement plan and done comparisons with treatment plans in the Mobius DoseLab software, just to be on the safe side. Making sure that we did not draw any wrong conclusions from the results.

DELTA4 PHANTOM+ MR AND VIEWRAY MRIDIAN

We treated our first patient on the MRIdian in May 2019 and to this date, we have treated about 50 patients. The MRIdian is a very different system compared to what we are used to. The steep learning curve operating the machine has led us to take a slow approach ramping up treatments on the MRIdian. We have not used the MRIdian to treat standard cases such as prostate cancers. Instead, we have focused on patients benefitting from the MR capabilities of the machine such as liver treatments and abdominal tumours, utilizing all features of the system with adaptive treatments, gating and tumour tracking.

WORKFLOW, MEASUREMENT & ANALYSIS

Since MRIdian is a completely new system for us we do not have much experience in treatment planning and the corresponding results. Because of this, we are measuring all treatment plans on the Delta4 Phantom+ MR before treatment. For evaluation, we are using the same criteria as for conventional linac.

Workflow

The Delta4 Phantom+ is easily transferred onto the couch by simply sliding it over from the Delta4 Trolley. The phantom is positioned with the machine´s external laser and a couch shift to the isocenter is then performed.

Measurement

A QA plan is created in the MRidian system where the plan is calculated on the Delta4 CT data. The couch on the MRidian is attenuating the beam quite heavily so the couch is included in the calculation. The plan is then exported to the Delta4 software, treatment is delivered and results measured in the phantom.

Analysis

The analysis is done with the gamma-analysis in the Delta4 software. Measurement profiles are also visually evaluated to get a sense of the plan quality. We are using a 3%/3mm local gamma and a 95% passing rate as our clinical plan criteria. We have not had any plans that failed these criteria and we have treated about 50 patients. ”

The team at Herlev: left to right, Ulf Bjelkengren, Susan Biancardo and Grichar Valdes Santurio

ECMP SILVER SUPPORTER

Sirtex Medical

Sirtex Medical is a global healthcare business with offices in the US, Australia, Germany and Singapore, working to improve outcomes in people with cancer.

Our current lead product is a targeted radiation therapy called **SIR-Spheres® Y-90 resin microspheres**.
SIR-Spheres® Y-90 resin microspheres are a medical device used in Selective Internal Radiation Therapy (SIRT) for treatment of unresectable hepatocellular carcinoma (HCC) and unresectable metastatic liver tumours from primary colorectal cancer in patients refractory to or intolerant of chemotherapy.

SIRT is a minimally invasive treatment that delivers high doses of high-energy beta radiation directly to the tumours.
For further information please visit www.sirtex.com.

Learn more about Sirtex in our interactive virtual booth https://www.sirtexvirtualbooth-emea.com

*SIR-Spheres® is a registered trademark of Sirtex SIR-Spheres Pty Ltd

ECMP GOLD SUPPORTER EFOMP COMPANY MEMBER

Sun Nuclear: Independent Quality Management Platform – Standardized Compliance through Customizable Machine QA

Documentation of Machine Quality Assurance (QA) data and procedures can be time consuming, extensive, and unclearly arranged. Daily linac performance measurements followed by monthly and annual QA, Imaging, VMAT and MLC QA tasks increase the amount of data that has to be organized and managed by physicists in radiotherapy departments.

The independent Quality Management Platform SunCHECK™ integrates all Patient QA phases and Machine QA in a single web-based application, accessible from any networked computer. SunCHECK enables clearly structured and complete Machine QA. Automated processes ensure significant efficiency gains, and a streamlined workflow within the clinic, or even across sites, reduces machine failures and increases machine uptime through trending capabilities. For this reason, over 1,000 users rely on Sun Nuclear's SunCHECK solution.

To create QA templates to a specific need, flexible customization tools are integrated in SunCHECK™ Machine allowing for the incorporation of every machine QA procedure. Task instructions, definition of setup parameters, setup/execution files and custom calculations can be added to every task. With these functionalities included, there is no further need for additional databases or file locations, separate calculations, or documentation tools, since **all machine QA data is managed within one streamlined application.**

There is a great variety of regional QA standards, the implementation of which has been a challenging enterprise for providers of QA software. As an example, the German DIN protocol is unique by providing users elaborate room for adaption, resulting in various locally different interpretations of the same DIN task.

The ability to customize QA tasks and share custom QA templates among peers allows users to adapt SunCHECK Machine to their specific needs. While SunCHECK users in Germany now benefit from DIN protocol

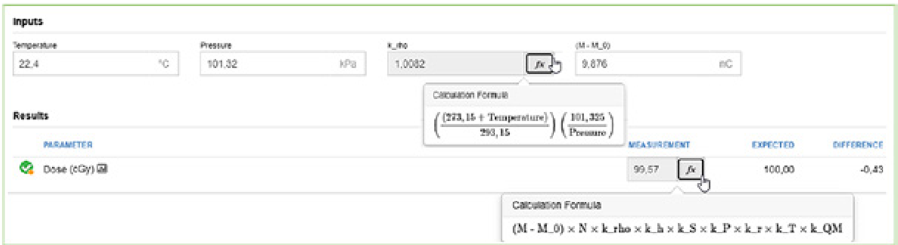


Figure 1: The Custom Math feature enables calculations in every QA task where needed, ultimately eliminating the need of additional documentation or calculation tools to process measured data.

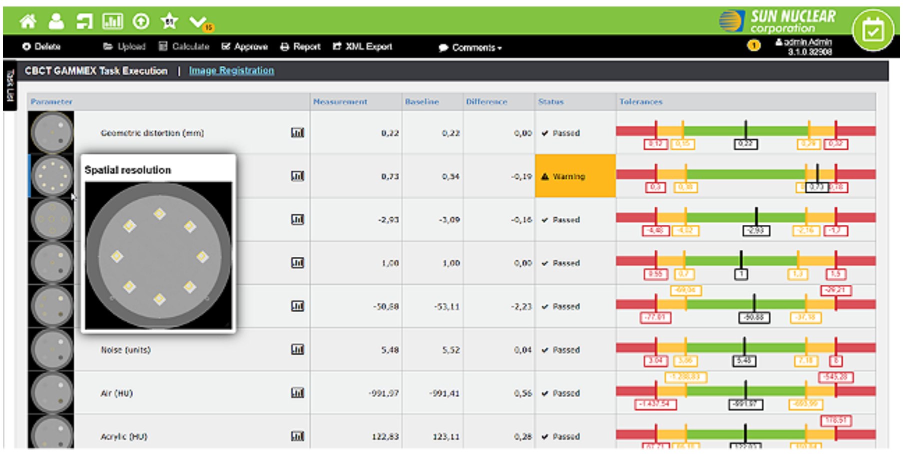


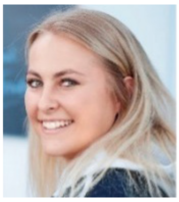
Figure 2: Display of CBCT Task Execution in SunCHECK Machine. Automated image retrieval, registration, and analysis ensure efficient and objectified imaging, VMAT and MLC QA.

support, including more than 85 tasks, these newly implemented customization functionalities allow compatibility and compliance with regional QA standards in addition to pre-defined TG-142 templates. In combination with custom report functionality, manageable machine QA is becoming easier than ever before.

Customers have found that using SunCHECK has resulted in significant time savings, including soon-to-be published research highlighting how SunCHECK has saved nearly two hours in one department's monthly imaging tests alone.

The latest version 3.2 software release brings 50+ feature enhancements. For Patient QA, advancements for secondary dose calculations for photons, electrons and brachytherapy plans are included in the new release, in addition to API connectivity. For Machine QA, further DIN-specific imaging and MLC tasks expand the DIN support in addition to the ability to share templates with other users.

For detailed information, publications, or a demo request, visit sunnuclear.com/suncheck.



Julia Kirchhefer, M.Sc. Medical Physics
Julia Kirchhefer is a Medical Applications Physicist in the team of Sun Nuclear, the leader in Quality Management solutions for Radiation Therapy and Diagnostic Imaging. She works closely with customers in Germany and Austria to help guide them through clinical application of Sun Nuclear's solutions. Before joining Sun Nuclear, Julia obtained a bachelor's and master's degree in Medical Physics at the Technical University of Dortmund in collaboration with the Institute for Radiation Protection and Medical Physics at the clinic in Dortmund.

Sun Nuclear Corporation

Experience the latest advancements to streamline Quality Management and support flexible workflows with Sun Nuclear.

Through our symposium and virtual booth, learn what's new — and what's possible — for today's Quality Management.

Featured in Our Booth

Browse resources for details on what's new. Highlights include:

- **SunCHECK™ — A Single Platform for your Patient & Machine QA**
  Over the past year, SunCHECK Platform users have nearly doubled to more than 1,000 users. We continue to enhance the platform to support the unique needs of Radiation Therapy departments worldwide. Featured enhancements include:
  - PlanCHECK™ module for automated plan quality checking
  - ArcCHECK® integration for enhanced Pre-Treatment QA root-cause analysis
  - Customizable Machine QA tasks and templates
  - Machine QA batch approvals
  - Expanded modality and regulatory support
- **Proven, Simplified SRS & SBRT QA**
  Clinics worldwide rely on SRS MapCHECK® for accurate and efficient stereotactic Patient QA. For departments performing Single-Isocenter Multiple-Target (SIMT) treatment plans, SRS MapCHECK enables efficient capture of multiple targets, and the MultiMet-WL Cube offers confidence in accurate delivery from the linac. StereoPHAN™ enables end-to-end stereotactic QA. Together, these solutions support stringent stereotactic programs.
- **Complete Quality Management**
  Sun Nuclear provides the broadest range of advanced Quality Management solutions, enabling departments to easily standardize their Quality Management programs. Review our solutions portfolio for our complete offering for Diagnostic QA, Patient QA, Machine QA/Dosimetry and Patient Alignment.

Symposium
On June 18th at 12:55 in Virtual Room Piemonte, join us for an educational symposium, **Improving Patient Safety - Advances in RT Quality Assurance**, featuring best practices from clinical users on automated QA and SRS end-to-end quality management.

Implementation of SunCHECK QA Platform in a Medium Size Department
Nuria Jornet, Ph.D., Hospital de la Santa Creu i Sant Pau, Barcelona, Spain

Using a High-Density Diode Array for SRS/SABR Commissioning
Peter Filatov, M.Sc, Genesis Care, Oxford, UK

To learn more about what Sun Nuclear has to offer, or to request a demo or quote on our solutions, visit sunnuclear.com.

ECMP SILVER SUPPORTER   EFOMP COMPANY MEMBER

Tecnologie Avanzate at the ECMP Congress

TECNOLOGIE AVANZATE

TECNOLOGIE AVANZATE VISION

The company mission is the continuous investigation, research and development of cutting-edge technologies tailored on customer needs. An idea based on competences, continuous training, curiosity and dynamism.

Our keywords for ECMP 2020 congress are: Synchrony real time tracking, ClearRT™ Helical Fan-beam kVCT, Radiomic Precision Metrics, Artificial Intelligence, GPS Ideal Dose, RT Plans Advanced Analysis, Patient Safety in RT, Breast Image Synchronization, Bone Strain Index.

These keywords well represent our multidisciplinary solutions which cover fields from medical physics and radiation therapy to nuclear medicine and radiology.

If you are looking for…

A high-fidelity kVCT imaging to see more, know more, and do more, experience clarity with ClearRT™ Helical Fan-beam kVCT.

An innovative treatment system for a real-time adaptive treatment delivery, take a look at Accuray Synchrony® system.

A solution for quick and easy quantitative data extraction to lead your radiomic projects and leverage radiomics into your clinical workflow, HealthMyne is the right platform.

Customized solutions that you have in mind for your specific everyday needs but you have not run into it yet, have a glance at our in-house solutions:

- An integrated RayStation-HealthMyne solution to empower your radiotherapy treatments with Radiomics. Personalize your report with the integration of treatment plan data and radiomic features.

- GPS 4.0 solution to obtain a greater personalization of the RT treatment, further reducing computational times. GPS 4.0 introduces the concept of personalized treatment plans with the automatic generation of an ideal dose distribution for each patient. This dose will be the starting point of the optimization algorithm, in this way the convergence to the optimal solution is faster.

- iTA DATA, the data analysis software for Radiation Oncology and Nuclear Medicine Departments. Ongoing projects for the evaluation of radiotherapy treatment plans as well as the analysis of the daily changes and the trend of treatment quality will be the added value of the upcoming releases.

- iTA TECH, our application for radiation therapy technicians to ensure maximum accuracy and precision of treatment.

- BONE STRAIN INDEX, a revolutionary software for a deeper knowledge of patient risk fracture.

- TOMONAV, innovative algorithms for a multiview and multimodal visualization of breast images.

Visit Tecnologie Avanzate's virtual booth and look at our material to learn more about our exclusive solutions.

Guido Catolla Cavalcanti is the CEO of Tecnologie Avanzate.
Visionary and creative Business Executive with 30 years of experience in health-care; he has particular expertise in business development and distributor management in the fields of radiotherapy, health physics and nuclear industry for hospitals, universities and private companies.

Tecnologie Avanzate srl company profile

Tecnologie Avanzate T.A. was founded in 1974. Since its establishment it has introduced on the Italian market innovative medical technologies in the field of nuclear physics and RX diagnostics. It has progressively focused on advanced systems such as solid-state dosimetry, nuclear medicine with special detectors and DSP technology and accelerators integrated with imaging.

In the following years the company has expanded its range of products opening up to new sectors such as radiotherapy, neurosurgery, radiology and imaging, establishing exclusive partnerships with multinational companies leaders in these sectors and with research centers at the forefront of software development, algorithms and clinical trials.

Tecnologie Avanzate T.A. has always focused its resources on developing and consolidating new technologies arising from the frontier research of radiation physics applied to medicine.

Scientific collaborations with centers of excellence and a continued investment in research projects at national and international level have allowed Tecnologie Avanzate T.A. to expand its expertise and extend the offered solutions to various sectors, from radiotherapy, to medical physics, to nuclear medicine and radiology.

DETECTOR Devices and Technologies Torino

DETECTOR Srl. was founded in 2009 as University of Turin spin out company, from a high energy physics research group that applied its skills and techniques to particle therapy applications, becoming a medical physics team.

Since the first projects, DETECTOR kept an experimental attitude that nowadays is magnified by the constantly evolving R&D portfolio activities.

While the company is committed for designing and developing state-of-the-art products for both medical and industrial applications, creating innovative particle therapy detector is still the group core-business. With this mission, DETECTOR is constantly involved in designing most of the device parts including microelectronics circuits, mechanics and integration systems, signal detection and sampling components as well as firmware and multi-platform software solutions.

Most of these activities are related to custom challenging applications in which DETECTOR is partner thanks to a strong international network developed in more than ten years showing up devices acknowledged by the scientific community as excellence reference in the field.

Keeping the focus on science and technology innovation trends worldwide, the team is ready to commit its efforts toward new projects and collaborations, like what is currently going on with FLASHQ, one of the latest R&D activities.

FLASHQ is a new ionization chamber conceived for high-intensity proton beam applications like those required by the Flash Therapy scenario. In this project dedicated design concepts as well as, specific devices for very large dynamic range are involved aiming to study the limits of both the physics and the technology for this detector that is the clinical gold standard.

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Varian: Regional Clinic in Sweden Boosts Planning Efficiency with RapidPlan

Machine learning technology helps small clinic maintain quality and consistency, while meeting the growing demand for radiotherapy services

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A Siemens Healthineers Company

Since its deployment in 2013, RapidPlan® knowledge-based treatment planning software has been widely deployed at cancer centres around the world. Still, a perception exists among some clinicians that RapidPlan is useful mainly for large institutions managing massive patient volumes.

However, at the regional hospital of Gävle in northern Sweden, RapidPlan is making a difference for a small medical physics team.

The Gävle regional hospital began using RapidPlan in 2017. Right from the start, medical physicists Per Hållström and Nils Andrae were pleasantly surprised at how easy it was to implement, even for a small clinic.

The team in Gävle, from left: Sandra Englund Freimuth, Anna Hellman, Birgitta Persson, and Towe Lindell (nurses and dose planners); Per Hållström and Nils Andrae (medical physicists).

"Early on, our goal was to use RapidPlan for head and neck sites, but we decided to start with some prostate salvage cases that were less complex," explained Hållström. "Planning for head and neck is a very complicated process and can involve many iterations for quality control, depending on the skills and experience of the treatment planner. We wanted consistent, high-quality plans to give our patients the best possible treatment."

To meet regional requirements for target and organ-at-risk delineation, the Gävle team built its own RapidPlan models based on high-quality prostate salvage treatment plans they already had created. As the medical physicists observed the model's effectiveness, they moved to head and neck planning with RapidPlan the following year.

"We needed at least 20 to 25 patient plans for creating a head and neck model, not including outliers," said Andrae. "Of course, the more patient plans you use to train the model, the better, and it's important to compare plans against additional test patients to verify the results."

Over the past three years, the team has made three revisions to the RapidPlan head and neck model based on 45 patient plans, and the prostate model now has on 108 plans in its database.

With both prostate and head and neck models well established in the system, the Gävle team is seeing the consistent, high-quality plans they had initially hoped to achieve.

"For prostate, we typically accept the first plan straightaway and for head and neck, we may have to do two iterations at the most," said Andrae. "A huge benefit has been that planning time has been reduced from hours down to about 30 minutes."

Furthermore, Andrae explained, advanced features in RapidPlan mean they no longer have to use support structures and crop them out later, and all organs at risk (OARs) are accounted for in the first plan.

"You always have everything you need in the initial plan, which saves time and gives us confidence that we're making the treatment as safe as possible for the patient," he said. "Even if the doctor decides to change something related to the target, once you have the model it's easy to create a new plan."

Despite being a small clinic, both medical physicists agree that the initial time and effort they put into developing the RapidPlan models have been well worth the time savings and reassurance that they're offering their patients the best possible treatment plans.

"Right from the beginning, the initial planning results are always very good—we've never had to scrap a plan and start again," Andrae explained. "We certainly would not want to go back to the days when we didn't have RapidPlan—we definitely don't miss those days."

A version of this article previously appeared in Centerline, Varian's online magazine for the clinical oncology community.

Julie Jervis is a science and technology writer living in Silicon Valley, California. Her articles have appeared in magazines and websites around the world, covering a diverse range of medical and technology topics, and her book, 'The World Beneath Their Wings,' follows the careers of leading women in aviation. In addition to editorial roles in the private sector, her background includes working for the World Health Organization, the International Maritime Satellite Organization, and NASA Ames Research Center.

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EUROPEAN FEDERATION
OF ORGANIZATIONS
FOR MEDICAL PHYSICS

The European Federation of Organisations in Medical Physics (EFOMP) was founded in May 1980 in London to serve as an umbrella organisation for medical physics societies in Europe. The current membership covers 36 national organisations which together represent more than 9000 medical physicists and clinical engineers working in the field of medical physics. The motto developed and used by EFOMP to underline the important work of medical physics societies in healthcare is “Applying physics to healthcare for the benefit of patients, staff and public”.

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