Schweizerische Gesellschaft für Strahlenbiologie und Medizinische Physik
Société Suisse de Radiobiologie et de Physique Médicale
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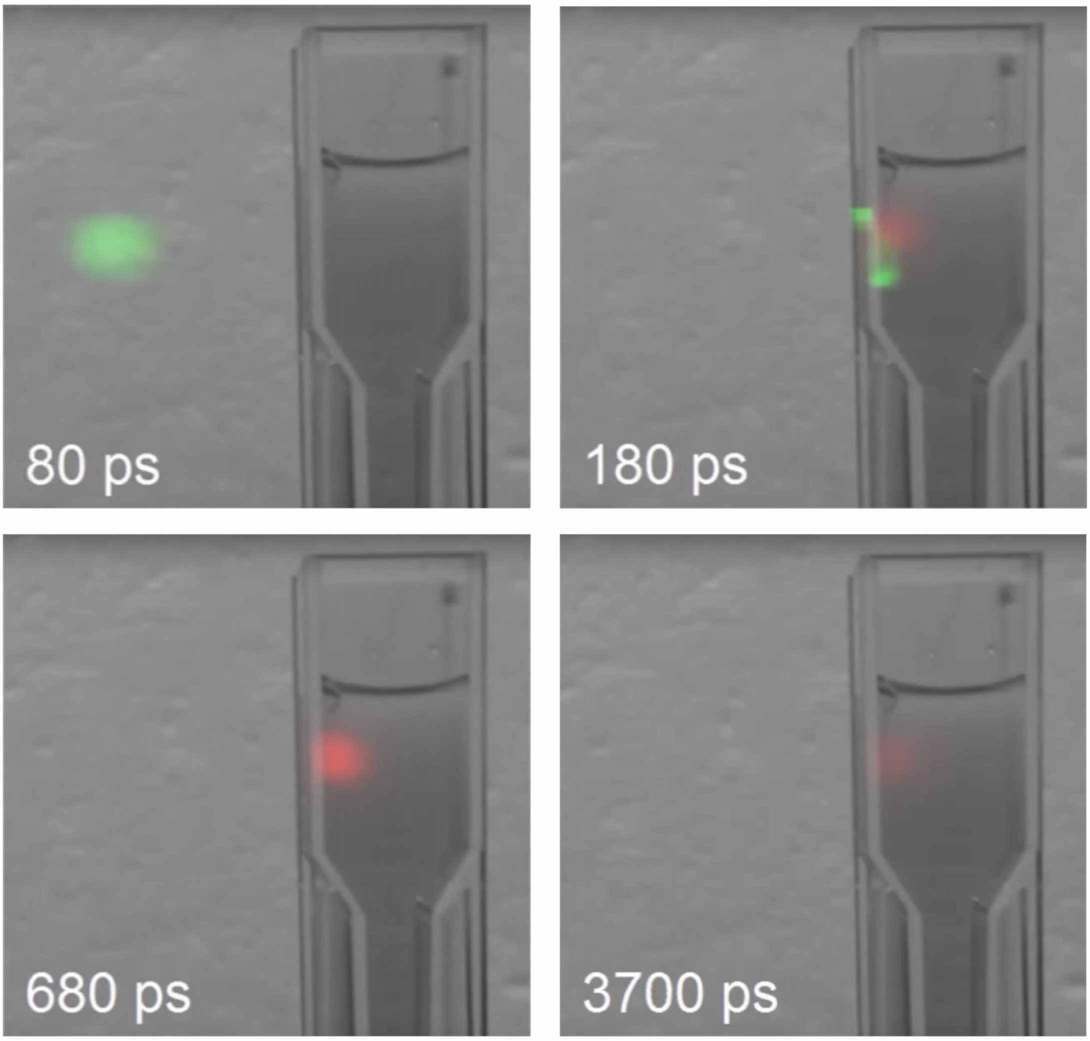

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Cover image:

Image compilation from a video entitled "Pulsed-laser-pumped fluorescence emission", taken using the compressed ultrafast photography (CUP) technology that was developed in the Department of Biomedical Engineering at Washington University in St. Louis. The CUP camera is able to take up to 100 billion frames per second.

See and read more:
(Video) https://www.youtube.com/watch?v=LqRZSmE110E
(Article) http://www.nibib.nih.gov/news-events/newsroom/ultrafast-camera-captures-images-speed-light-0
(Paper) http://www.nature.com/nature/journal/v516/n7529/full/nature14005.html#affil-auth

LETTER FROM THE EDITORS

Dear Colleagues,

This summer has been a hot one thus far and we hope everyone is making the most of it whether out on vacation or having a relaxing stay-cation.

The August bulletin is always the hardest one to put together since many of us are out of the clinic and enjoying the sun. So we want to give an even bigger thanks to those of you who persevered the sunny temptations outside and contributed to this bulletin. There are some very good articles worth reading. Unfortunately, this bulletin is without its “Spotlight on” article however the series will pick back up right where it left off in the December issue.

As the bulletin’s editorial team we are always happy to receive your news, articles, conference reports, or anything else that you members feel like sharing with the rest of the society. We look forward to your contributions so please share.

Enjoy the heat while it lasts!

Nathan Corradini, Shelley Bulling, and Francesca Belosi

President's letter

Dear colleagues,

Do you remember? It is now 15 years ago when a symposium took place with the title "Lage und Zukunft der Medizinischen Physik in der Schweiz". The meeting was organized by the Basel medical physics group and was accompanied by a survey launched by SSRMP. You can download the corresponding report No. 19 from the SSRMP website. This symposium was one of the first times when I was in touch with SSRMP-related issues. At that time, I had just started my PhD in medial physics and I was absolutely sure to have made the right decision to specialize in the field of medical physics. My motivation was huge and I was full of enthusiasm - not to say that I was hungry. Nevertheless, I remember very well that, when attending this symposium, I was astonished and quite a bit upset by the fact that people were discussing about the future of *my* field. As a greenhorn, I could not see the importance of raising questions about the relevance and the future role of medical physics. For me it was clear that medical physics *is* the future and that it is going to be *my* future as well.

Today, the field of medical physics is still alive. Moreover, medical physics evolved and medical physicists (incl. me) evolved as well. One of the issues, which were addressed in the aforementioned symposium, was the "missing medical physicist in radiology and in other medical disciplines". Well, today, we can say that this is established. Of course, it is not fully complete, yet, and there is still a lot to do in the future. But, nowadays, we are actively applying concepts of physics not only in radiation oncology and radiology but also in different specialties like cardiology, urology, orthopedics, etc. It is my sincere conviction that this implementation of medical physics is a success story, mainly in the context of safe and appropriate usage of ionizing radiation in different clinical settings. Unquestionably, I am convinced that the hospital employees and especially the patients are very thankful to everything what medical physicists were and are doing, these days*.

Another success story related to SSRMP is the fact that the impact factor of our journal – Zeitschrift für Medizinische Physik – has recently achieved a value of 2.963. This is a fantastic value and it has only been possible due to hard working people (editors as well as authors and reviewers) to which I would like to express my sincere gratitude: Congratulations and many thanks to all of you! In principle, the importance of having a high impact factor is obvious and does not need any further explanations. Let me anyway emphasize that the impact factor is expressing the high quality of all the scientific efforts performed in our field of medical physics. It is thus also demonstrating that we are gradually improving the "Lage and Zukunft der Medizinischen Physik in der Schweiz".

Now, looking at the current bulletin, I am happy to see that there is still a lot of work to be done. The annual meeting 2015 is in preparation and I hope that many of you are actively supporting it and submitting abstracts. Your contribution and your participation is important for our field and I look forward to seeing you in Fribourg soon.

Now, enjoy this bulletin.

Peter Manser

* By the way: I know what I am talking about because I personally was feeling very confident when I recently had to be CT-scanned after a mountain bike accident. When I was moved forward into the CT scanner, I had the picture of the medical physicist in mind doing some QA work for this specific CT and I "saw" him developing strategies on how to improve and adapt current protocols. Just having these pictures in mind helped me a lot...

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Annual scientific meeting 2015

Fribourg, October 21-22

Good to know:

- Prepare your abstracts : In order to proceed, follow the instructions at http://physmed.net/SSRMP2015/abstracts.html
  • Deadline (no extension accepted) : Monday, August 31
- Registration required (no charge) : Follow the instructions http://physmed.net/SSRMP2015/registration.html
  • Deadline : October 12
- Book your hotel : Detailed instructions at http://physmed.net/SSRMP2015/hotel.html
  • By phone number : +41 26 3519223 (NHhotels, Fribourg)
  • By email : reservations.nhfribourg@nhhotels.com
  • Key word : "Meeting SSRMP 2015"
  • Deadline : September 14, 2015. Warning the principle "first come first served" is applied.
- Book your seat at the restaurant for the evening of October 21 : See the instructions at http://physmed.net/SSRMP2015/social_event.html
  • Cost : 60.--
  • Limited number of people : 90 (Warning the principle "first come first served" is applied.)

Summary of MIP workgroup meetings

The MIP Workgroup is divided into three subgroups, which regularly report to the workgroup. Contributions came from all subgroups. There are 4 meetings annually and the last meetings were on 21st April and 18th August, both at the University of Bern.

Feedback from working groups

CT - On the first meeting, Gerd Lutters brought to discussion the IAEA publication on dosimetry on wide CTs which started the discussion on current stages of CTDI measurements and the need for a Swiss standardisation in CTDI measurements in RT, DR and NM and whether the vendors should give recommendations on this topic. It was also discussed the need for evaluation of CTDI efficiency. CHUV benchmarked some protocols for air kerma measurements and the evaluation of low contrast detectability, which should always be taken into account when evaluating the protocols. It was asked for them to produce guideline steps for the other centres to follow regarding the CT tasks. It was also discussed the differences between CTDI vs SSDE (Size Specific Dose Estimate, AAPM) for dose evaluation. It was requested to CHUV to introduce these to the group as a teaching session. CHUV also introduced the Eur Rad Soc defined protocols for CT, which have been taken by the Swiss Rad Soc and FDA's suggestion to use low contrast detectability in image quality CT.
On the second meeting, the group presented two different approaches in respect to image quality assessment in CT. Nick Ryckx, CHUV, introduced the model observer used at CHUV for evaluating low contrast detectability and their obtained results at CHUV. Stephan Scheidegger, KSA/ZHAW introduced an in-house phantom for evaluating different aspects of CT image quality (i.e. MTF, SNR, CNR …). He described the process and the rationale of developing such tools. Ismail Ozden, KSA, described the obtained clinical results using the phantom introduced by Stephan and described scenarios cases where the phantom was used for optimising patient dose and image quality.

Fluoroscopy - On the first meeting Roland Simmler reported that he is currently working on some dose optimization of protocols and that he hopes to present those results soon. This introduced the discussions on possible standardization of protocols within centres especially with regards to the DAP and peak skin doses above 5 Gy. This subgroup is to suggest a standard method for measurement for dose and propose recommendations on protocol for measurements and the amount of contrast used.
On the second meeting, Jörg Binder described the work done with i2dose (Raysave) live monitor for staff training purposes.

Nuclear Medicine - In the first meeting, Silvano Gnesin discussed the work presented in the paper: "Variation of system performance, quality control standards and adherence to international FDG-PET/CT imaging guidelines – a national survey of PET/CT operations in Austria" and Thiago Lima introduced the current discussions, between members of the group, regarding proposed protocols for similar work for the Swiss Nuclear Medicine Departments including both PET and SPECT systems.
To finalize Thilo Weitzel, who was involved in this work, presented his platform for the analysis of image quality esp. the point spread function in PET used by the Austrian audit paper. He proposed the use of his tool for the Swiss inter-comparison and requested some sample data for testing the different protocol currently used in Switzerland.
On the second meeting, Tilo Weitzel introduced the initial idea for a protocol to be used. The group is going to discuss further the specific points of this proposed procedure in order to reduce the extra efforts needed. During the initial part of the discussion it was pointed out the different interpretation by different

vendors in respect to the KP5. During the feedback stages of the reviewed RP Ordinance (to be published on 15. Sep 2015) it is to the society to comment on this issue and perhaps ask for clarification on this matter. Silvano Gnesin, CHUV, discussed the comparison work currently being done with the participation of other members of the Nuclear Medicine group to extend the comparison survey mentioned by Tilo Weitzel to other topics like image quality in SPECT and CT,DLP,CTDi dose reference levels in Nuclear Medicine devices.

Varia

Jörg Binder reported on the SGR radiation protection leporelos final results, which have now being agreed by the board of SGSMP.
Gerd Lutters reminded participant to subimit abstract to the coming SGSMP annual meeting and mentioned about the next SGSMP Education Day (27. Nov 2015) that will take place in Aarau and will cover imaging modalities from dosimetry to image quality.
Jörg Binder mentioned that Roland Simmler is preparing an actualisation course for members willing to maintain their German Radiation Protection registration.

Next meeting will take place on 17th November.

Report of SSRMP Research Grant 2013

A novel approach to the reference dosimetry of proton pencil beams based on dose-area product

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1 Introduction

The reference dosimetry of clinical proton beams is described in IAEA TRS-398 (Andreo *et al* 2000) and ICRU 78 (ICRU 2007). This Code of Practice recommends the determination of the absorbed dose to water (D_w) in the centre of a broad field (e.g. 10×10 cm^2) with a 'point-like' ionization chamber (IC). In proton (and heavier charged-particle) pencil beam delivery systems, a broad field can be delivered by scanning the (narrow) pencil beam laterally (i.e. across the plane perpendicular to the beam direction). The scanning techniques most commonly used are uniform-scanning, spot-scanning and raster-scanning. This way of producing a broad field has nevertheless one main drawback: it is very sensitive to delivery errors—in particular, to beam position errors. That is, small errors in beam position during the delivery of the field might have a significant effect on D_w at the reference point of measurement (i.e. at the centre of the field). A more natural, and more robust, approach to the reference dosimetry of narrow pencil beams is the determination of the dose-area product (D_wA) with a large-diameter ionization chamber. The dose-area product, also called integral dose (Pedroni *et al* 2005), is the integral of D_w over the whole plane perpendicular to the beam direction. That is, instead of determining D_w at the centre of a broad field with a small detector, to determine D_wA of a small field with a large detector. These two approaches are reciprocal and therefore equivalent, as it will be shown below in section 2.

The dose-area product is a dosimetric quantity extensively used in diagnostic radiology (IAEA 2007). In particle therapy, it is typically used to express the integral depth dose curve (Pedroni *et al* 2005) of proton (or heavier charged-particle) pencil beams (ICRU 2007). The use of D_wA for the reference dosimetry of small radiotherapy beams was first suggested by Djouguela *et al* (2006) for narrow photon beams and it was later used by Gillin *et al* (2010) to calibrate the beam monitor chamber of a spot-scanning proton beam delivery system. In both cases, the authors cross-calibrated a large-diameter IC against a reference cylindrical IC in a broad field. Gillin *et al* (2010) also assumed a constant beam quality correction factor ($k_{Q,Q0}$) for all the measured proton beam qualities. In this work, we followed the IAEA TRS-398 dosimetry formalism to explore the reference dosimetry of proton pencil beams based on D_wA. Firstly, we calibrated a large-diameter ionization chamber in terms of D_wA in a ^{60}Co beam. Secondly, we experimentally determined the dosimeter beam quality correction factor, as in Gomà *et al* (2015). Finally, we compared the dose-area product approach to the standard "broad field–small detector" approach. The advantage of pencil beam scanning delivery systems is that they are capable of delivering a homogeneous broad-field by the superposition of narrow-fields—which establishes an analytical relationship between the broad and narrow field dosimetry, as it is shown below. Thus, proton (or heavier charged particles) pencil beam scanning delivery systems are the ideal delivery systems to test the novel approach to reference dosimetry described in this work.

2 Theory: the reciprocity theorem

The reciprocity theorem states that (Attix 1986):

> Reversing the positions of a point detector and a point source within an infinite homogeneous medium does not change the amount of radiation detected.

Mayneord (1945) extended the reciprocity theorem to the case where the source and detector were both extended volumes. Expressed in modern terminology, it states that:

> The absorbed dose in a volume *V* due to a radiation source uniformly distributed throughout a source volume *S* is equal to the absorbed dose that would occur in *S* if the same activity density per unit mass were distributed throughout *V* .

Our particular problem is a restricted case of the theorem above, with one volume being a surface *S* and the second volume, a point *P* . That is, the reciprocity theorem applied to our particular problem may be expressed as follows:

> The absorbed dose in a surface detector *S* due to a point source *P* is equal to the absorbed dose in a point detector *P* if the same particle fluence Φ is distributed throughout *S*.

In this section, we will demonstrate the theoreom above. In particular, we will derive the relationship between (i) the integral dose ($D_w A$) of a proton pencil beam of lateral Gaussian shape and (ii) the point dose (D_w) at the center of a uniform field generated by the superposition of an infinite number of equally-spaced proton pencil beams.
To begin with, we will define $D(x, y, z)$ as the absorbed dose to water at a point (x, y, z) in space delivered by a given radiation field. If the z-axis defines the beam direction, the integral dose, $D(z)$, is defined as the integral of $D(x, y, z)$ over the plane perpendicular to the beam direction, i.e.

$$D(z) \doteq \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} D(x, y, z) \mathrm{d}x \mathrm{d}y \tag{1}$$

When the radiation field is a single proton pencil beam of lateral Gaussian shape travelling along z and centered at (x_0, y_0),

$$D(x, y, z) = D(x_0, y_0, z) \exp\left(-\frac{(x - x_0)^2}{2\sigma_x^2}\right) \exp\left(-\frac{(y - y_0)^2}{2\sigma_y^2}\right) \tag{2}$$

where $D(x_0, y_0, z)$ is the dose at the center of the pencil as a function of z; and σ_x and σ_y are the standard deviation of the Gaussian function in the directions x and y, respectively. σ_x and σ_y are also a function of z, but this dependency is ommited in equation (2) for the sake of clarity. In this case, the integral dose is $D(z) = 2\pi\sigma_x\sigma_y D(x_0, y_0, z)$; so equation (2) may also be expressed, in terms of $D(z)$, as follows:

$$D(x, y, z) = \frac{D(z)}{2\pi\sigma_x\sigma_y} \exp\left(-\frac{(x - x_0)^2}{2\sigma_x^2}\right) \exp\left(-\frac{(y - y_0)^2}{2\sigma_y^2}\right) \tag{3}$$

Let's now consider the case of a broad uniform field resulting from the superposition of an infinite number of proton pencil beams—equation (3)—separated a distance δx and δy between them. In this case,

$$D(x,y,z) = \sum_{k\epsilon\mathbb{Z}} \sum_{l\epsilon\mathbb{Z}} \frac{D(z)}{2\pi\sigma_x\sigma_y} \exp\left(-\frac{(x-\ k\delta x)^2}{2\sigma_x^2}\right) \exp\left(-\frac{(y-\ l\delta y)^2}{2\sigma_y^2}\right) \tag{4}$$

where k and l extend over all the integer numbers $\mathbb{Z}$. Since the field is uniform (by definition), equation (4) may be re-written as:

$$\begin{aligned} D(x,y,z) &= D(0,0,z) \\ &= \frac{D(z)}{2\pi\sigma_x\sigma_y} \sum_{k\epsilon\mathbb{Z}} \exp\left(-\frac{(x-\ k\delta x)^2}{2\sigma_x^2}\right) \sum_{l\epsilon\mathbb{Z}} \exp\left(-\frac{(y-\ l\delta y)^2}{2\sigma_y^2}\right) \qquad (5) \\ &= \frac{D(z)}{2\pi\sigma_x\sigma_y}\ I(x)I(y) \end{aligned}$$

where $I(x)$, and $I(y)$, are defined as:

$$I(x)\ \doteq \sum_{k\epsilon\mathbb{Z}} \exp\left(-\frac{(k\delta x)^2}{2\sigma_x^2}\right) \tag{6}$$

Defining $s_x = \sigma_x/\delta x$, equation (6) may be re-written as:

$$I(x) = \sum_{k\epsilon\mathbb{Z}} \exp\left(-\frac{k^2}{2s_x^2}\right) \cong \int_{-\infty}^{+\infty} \exp\left(\frac{k^2}{2s_x^2}\right) \mathrm{d}k = \sqrt{2\pi}\ s_x \tag{7}$$

where in the second equality we used the Euler-McLaurin formula (cf Graham *et al* 1990)— which (i) for a Gaussian function with $s_x \geq 1$ and (ii) for the accuracy needed in radiation therapy reference dosimetry, we can safely assume to be exact. Thus, substituting $I(x)$ and $I(y)$ in equation 5, it follows that:

$$D(0,0,z) = \frac{D(z)}{\delta x\ \delta y} \tag{8}$$

That is, the absorbed dose at the center of a uniform broad field $D(0,0,z)$ resulting from the superposition of an infinite number of proton pencil beams equally-spaced a distance δx and δy between them, it is equal to the integral dose of a single pencil beam $D(z)$, divided by the spacing δx and δy between adjacent pencil beams. Note that the term $1/\delta x\ \delta y$ guarantees that the fluence Φ is the same in both the point and surface source. Note also that, for divergent beams, δx and δy are also a function of z.

3 Materials and methods

3.1 Large-diameter ionization chamber

In this work, we used a PTW 34070 Bragg Peak Chamber (PTW Freiburg, Freiburg, Germany), a large-diameter plane-parallel ionization chamber. According to the manufacturer specifications, the radius of its sensitive volume is 40.8 mm, the guard ring width is 1.1 mm and the entrance window has a nominal thickness of 3.47 mm—which corresponds to a 4 mm photon water-equivalent thickness.

3.2 Calibration in terms of $D_{\mathrm{w}}A$ in a ^{60}Co beam

The Bragg Peak Chamber (BPC) was calibrated in terms of $D_{\mathrm{w}}A$ in the ^{60}Co beam at the Swiss Federal Institute of Metrology METAS, a Primary Standards Dosimetry Laboratory. To the extent possible, we followed the IAEA TRS-398 reference conditions for ^{60}Co beams. That is, we set the reference point of the chamber at a depth of 5 g cm^{-2} in water and the source-to-chamber distance to 100 cm. The reference point of the BPC was taken to be the center of the inner surface of the entrance window, i.e. 3.47 mm below the center of the outer surface of the entrance window. The only exception with respect to the IAEA TRS-398 reference conditions was the field size, which was set to 22 × 22 cm^2, in order to guarantee a sufficiently uniform D_w across the entire chamber surface.

To be able to trace the $D_{\mathrm{w}}A$ calibration to the METAS primary standard (water calorimetry), we performed the following steps:

1. With a secondary standard (NE2571 Farmer chamber), we determined the ratio between D_{w} at the center of the 22 × 22 cm^2 field and D_{w} at the center of the 10 × 10 cm^2 (reference) field. In this step, possible variations in the photon beam quality between calibration (22 × 22 cm^2) and reference (10 × 10 cm^2) conditions were assumed to be negligible.

2. With an IBA PFD-3G diode (IBA Dosimetry GmbH, Schwarzenbruck, Germany), we measured a two-dimensional D_{w}-map of the entire 22 × 22 cm^2 field, relative to the field center. With this field map, we determined the ratio between D_{w} at any point in the 22 × 22 cm^2 field and D_{w} at the center of the 22 × 22 cm^2 field.

With these two measurements, we obtained a two-dimensional map of the absolute D_{w} (because traceable to the primary standard) in the entire 22 × 22 cm^2 field. To determine the calibration factor of the BPC in terms of $D_{\mathrm{w}}A$ ($N_{DA,\mathrm{w}}$), we integrated D_{w} over the charge-integration surface of the BPC. At this point, we assumed a charge-integration radius of the BPC of 40.8 mm. Finally, dividing by the charge-integration surface of the ionization chamber, we also determined the standard calibration factor of the BPC in terms of D_{w} ($N_{D,\mathrm{w}}$). That is, the two calibration factors relate as follows:

$$N_{DA,\mathrm{w}} = N_{D,\mathrm{w}}\, \pi\, r^2 \tag{9}$$

where r is the charge-integration radius of the BPC chamber. Note that r enters directly in $N_{DA,\mathrm{w}}$, so the uncertainty of this value has a direct impact on the uncertainty of $N_{DA,\mathrm{w}}$. Last but not least, it is should be mentioned that the calibration is terms of $D_{\mathrm{w}}A$ assumes a uniform response of the BPC across the entire charge-integration surface.

3.3 Experimental determination of k_Q

We determined the beam quality correction factor (k_Q) of the BPC experimentally, as described in Gomà *et al* (2015). In this work, we determined the ratio between the k_Q of the BPC and a PTW 23343 Markus chamber, for a proton beam quality of $R_{res} \cong 6$ g cm^{-2} . The reference proton field was a 100 MeV quasi-monoenergetic[1] 10 × 10 cm^2 field and the reference measurement depth was chosen to be at a depth of 2 g cm^{-2} in water (Gomà *et al* 2014)—leading to a residual range of $R_{res} \cong 6$ g cm^{-2}. As in the ^{60}Co beam, the reference point of the BPC was taken to be the center of the inner surface of the entrance window, i.e. 3.47 mm below the center of the outer surface of the entrance window. Also as in the ^{60}Co beam, we accounted for the inhomogeneity of the broad proton field, in this case due to the non-uniformity of the beam monitor chamber response across the scanning plane.

3.4 D_wA determination of a proton pencil beam

Making a parallelism with IAEA TRS-398 formalism, we determined D_wA as follows:

$$(D_wA)_Q = M_Q\, N_{DA,w}\, k_Q \tag{10}$$

where M_Q is the reading of the ionization chamber in the proton beam quality Q and $N_{DA,w}$ is the calibration factor of the chamber in terms of D_wA in the ^{60}Co beam. We set the reference point of the BPC at a depth of 2 g cm^{-2} in water and we determined D_wA for different quasi-monoenergetic proton pencil beams with energies ranging from 70 to 230 MeV. As in Gillin *et al* (2010), we assumed a constant k_Q value for all proton beam qualities. We recorded the number of monitor units (MU) per proton pencil beam.

3.5 Comparison with D_w determination in a proton broad field

Finally, we determined D_w at the center of a 10 × 10 cm^2 field with the Markus chamber, which had been previously calibrated in terms of D_w at METAS. As described in Gomà *et al* (2014), we set the reference point of the chamber at a depth of 2 g cm^{-2} in water and we determined D_w at the center of different quasi-monoenergetic 10 × 10 cm^2 fields with energies ranging from 70 to 230 MeV. The distance between adjacent spots was $\delta x = \delta y = 2.5$ mm. Also here we assumed the k_Q of the Markus chamber constant for all proton beam qualities. We recorded the number of MUs per proton pencil beam. Using equation (8), we compared D_w determined with the Markus chamber at the center of 10 × 10 cm^2 field with D_wA of a single pencil beam determined with the BPC.

4 Results and discussion

The calibration factors of the BPC in terms of D_w and D_wA were found to be:

$$N_{D,w} = (3.037 \pm 0.013) \times 10^6 \text{ Gy C}^{-1} \tag{11}$$

$$N_{DA,w} = (1.588 \pm 0.008) \times 10^4 \text{ Gy m}^2 \text{ C}^{-1} \tag{12}$$

where the uncertainty value corresponds to one standard uncertainty ($k = 1$). Note that for $N_{D,w}$ the relative standard uncertainty is 0.4%, whereas for $N_{DA,w}$ is 0.5%. As mentioned above, this is due to the

[1] The term quasi-monoenergetic is used to stress that clinical proton beams are not monoenergetic, but have an inherent initial energy spread.

fact that the uncertainty in the BPC charge-integration radius— which we assumed to be $\delta r = 0.1$ mm, according to the manufacturer drawings—contributes significantly to the final uncertainty budget.
The ratio between the k_Q of the BPC and the Markus chamber for $R_{res} \cong 6$ g cm^{-2} was found to be:

$$k_Q^{\text{BPC}} / k_Q^{\text{Markus}} = 1.009 \pm 0.005 \qquad (13)$$

where the uncertainty value corresponds again to one standard uncertainty ($k = 1$). Thus, based on the k_Q of the Markus chamber tabulated in IAEA TRS-398 ($k_Q = 1.002 \pm 0.021$), we found that the k_Q of the BPC for $R_{res} \cong 6$ g cm^{-2} is $k_Q^{\text{BPC}} = 1.011 \pm 0.021$ ($k = 1$).
Finally, figure 1 shows the comparison between the D_wA (per MU) of a single pencil beam determined with the BPC and the D_w (per MU) at the center of a 10 × 10 cm^2 field determined with the Markus chamber—converted to D_wA through equation (8). We found an average discrepancy between the two approaches of 0.3%, which is well within the uncertainty of the comparison. Note that, only the uncertainty associated to the BPC charge-integration radius ($u \sim 0.3\%$) could explain this discrepancy. Another cause of such a discrepancy could be a non-uniformity of the BPC response across the charge- integration surface. For instance, a slight deformation of the central part of the entrance

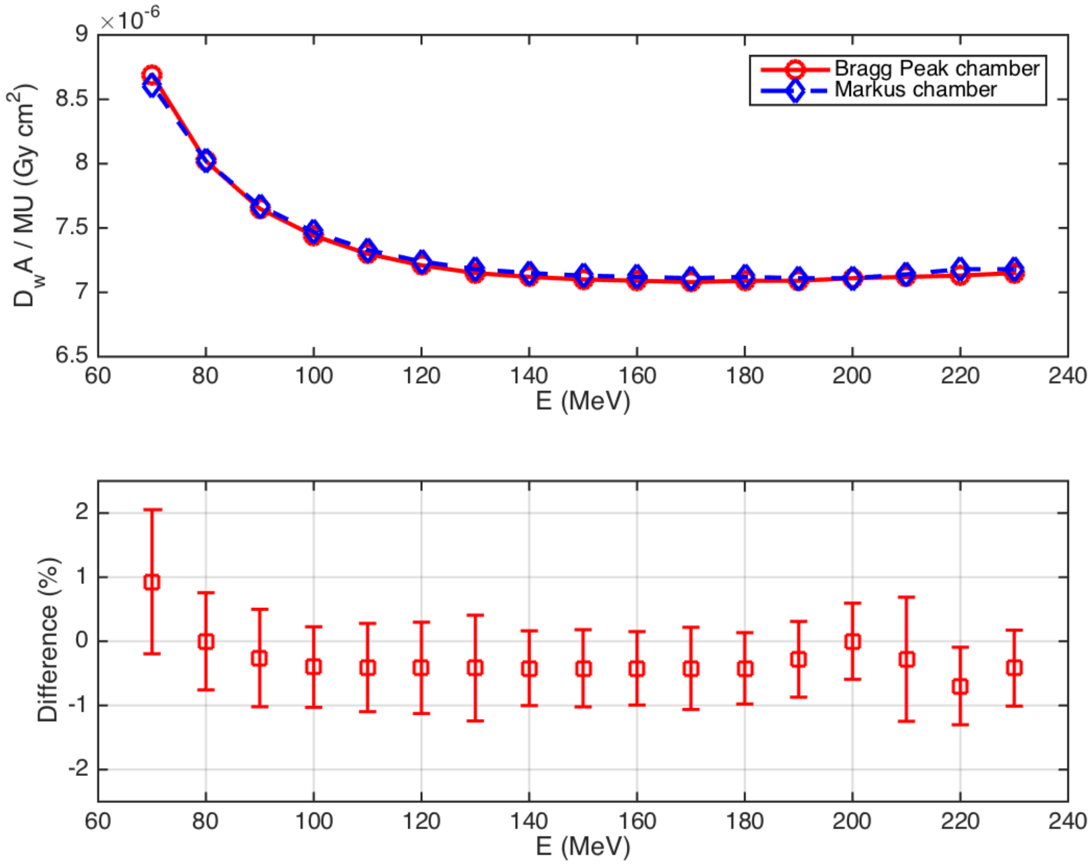

Fig. 1: Top: D_wA of a proton pencil beam per MU, as a function of proton energy, determined with the Bragg Peak (solid line) and the Markus chambers (dashed line). Bottom: Difference between the Bragg Peak and the Markus chamber D_wA determination.

window due to water pressure would lead to a slight underestimation of the D_wA with the BPC. Note also that the uncertainty is larger for low-energy proton beams. This is due to the uncertainty in

positioning the ionization chambers at the reference depth (type B), which for low-energy proton beams results in a larger uncertainty in the IC readings, due to the steeper dose gradient at the measurement depth of 2 g cm^{-2}.
All in all, this work shows that the reference dosimetry of proton pencil beams in terms of $D_w A$ is a feasible alternative to the standard D_w approach. The main drawbacks of this alternative approach, as compared to the standard one, are: (i) the charge-integration radius of the large-diameter IC must be known with a high-level of accuracy, and (ii) due to lack of information, the response of the IC across the charge-integration surface has to be assumed uniform. These assumptions contribute therefore to increase the uncertainty of the $D_w A$ approach, with respect to the standard D_w approach.

5 Conclusions

This work describes a novel approach to the reference dosimetry of proton pencil beams based on the dose-area product. We showed this novel approach is equivalent to the standard D_w approach and its only drawback is a larger uncertainty in the ionization chamber calibration factor. Nevertheless, there might be other scenarios where this larger uncertainty could potentially pay off. An example of that could be the reference dosimetry of very narrow photon beams, where other factors—such as the size of the detector—might introduce an larger source of uncertainty. The reference dosimetry of narrow photon beams based on $D_w A$ will be the subject of future research. If proven successful, the Swiss Federal Institute of Metrology METAS would be in the position of being the first PSDL capable of providing ionization chamber calibration factors in terms of $D_w A$ for the reference dosimetry of small radiotherapy beams.

Acknowledgements

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Continuing Education Day 2015

"Dose from X-Ray and nuclear medicine procedures"

27 November 2015

Kantonsspital Aarau, Hörsaal Haus 1

The program addresses advanced topics in the field of Dosimetry, dose optimisation and radiation protection. Lectures will be given by Medical, Physics and Technical experts in the field.

Preliminary Program Outline (8:45 to 16:15),
small coffee breaks and at 12:45, 45-min lunch break at restaurant "le Clou".

9:00 X-Ray Dose Concepts
10:45 Clinically relevant Image Quality
13:30 Clinical and Technical Parameter Space
15:00 Dose Optimization: A Special Topic

The meeting place can easily be reached by train (Aarau main station) and by foot (indicated at back exit of the station). Coffee and snacks are provided by the cafeteria "Santerra" (upstairs of the Auditorium) and during the 45 min Lunch break a full meal can be taken at the hospital restaurant "le Clou" located in the neighbouring building.

Participants need to register in advance. Details will be published soon on SGSMP internet page.

Report on SGSMP Continuing Education Day

20.08.2015, Bern

The 1st clinical education day organized by the SGSMP took place the 20th of August, in Bern.

The course is meant mainly for candidates of the final official certification as medical physicist. We were around 24-25 people sitting in one of the rooms of the main building of the University. We were asked whether we like the idea of further days similar to that one, possibly proceeding in topics concerning radiobiology…well…listening to Rapahel Moekli we don't have many choices…so…four other continuing education days are expected, for a total of 5 over 1 year period.

The morning was totally covered by Dr. Martin Pruschy. Some of the basis of Radiobiology was recalled: how can we enlarge the therapeutic window, the origin of tumor cells, the DNA structure (I think I am able to hear 1000 times that in each cell we have 2 m of DNA, tightly packed in 10 µm and still be impressed as it's something I've never heard!), 3 of the 5 Rs of radiobiology, cell death, survival curves… For whom is on his/her trip towards the exam it was for sure an efficient summary, and for whom has just started his/her Fachanerkennung it was for sure an useful introduction. Actually, it was more like a discussion between Martin Pruschy and us rather than a lecture, very interactive and that led us to really realize where these "radiobiology notions" enter in our practical every day clinical experience.

The afternoon was focused on breast cancers. Most of the time we started learning with the patient's history at the stage in which there's already a planning CT with some volumes contoured. Prof. Dr. Frank Zimmermann informed us about all what comes before: patients' suspicions, clinical visits, biopsy, surgeries (sometimes more than one), staging, chemo/hormone therapy, antibodies, and the many decisions that the patients have to take at each step. We talked about the different fractionation schedules, APBI and the different trials going on. Finally we got an overview of the ways the patients can be offered with a breast reconstruction: the different outcomes, drawbacks (especially related to RT following the surgery) or advantages.

As the day's closure, Dr. Goetz Kohler presented us with treatment planning of breast cancer. Of course the most discussed technique was the traditional 2 tangential fields, but also the field-in-field, IMRT were mentioned and the possibility of mixing energies and photons and electrons. Again the discussion was very interactive and a good opportunity for comparing our experience with the ones of our colleagues. Also the ICRU 50 definitions of Reference Point, D_{max}, D_{min} and target coverage were recalled….with the remark that it's good to maintain definitions, but when we plan we shouldn't be happy with having the V95% > 95%, but always aiming to achieve the best target coverage.

After, Dr. Goetz Kohler's lecture, the course ended and for those (like myself..but I had good company) who like wine, a glass of white Pinot while enjoying the shiny and warm afternoon, the view of the mountains over Bern in the wide terrace of the university was the perfect conclusion for that day!

Francesca Belosi, PSI

The implementation of clinical audits for an optimized use of ionising radiation

Lead:

The average exposure of the Swiss population to ionising radiation associated with medical applications has increased significantly in recent years. Many of these examinations and treatments may not be justified. In order to improve the actual situation, the Federal Office of Public Health (FOPH) has launched in close collaboration with various professional societies including the SSRMP the implementation of clinical audits in Switzerland. An introduction of such a peer review system has the potential to minimise the number of unjustified examinations and treatments with ionising radiation and to optimise the associated processes and resources.

In the current pilot phase, auditors have been trained and detailed contents of the audits have been developed in the areas of radiology, radiation oncology and nuclear medicine. The first pilot audits are scheduled for this autumn.

Main text:

Technology in the areas of diagnostic radiology, nuclear medicine and radiation oncology has developed rapidly in recent years. Patients stand to benefit greatly from these developments. However, increased use of these techniques also leads to a continuous increase in radiation exposure. Other factors which can contribute to an increased exposure include lack of expertise, insufficient awareness of the need for radiation protection, lack of training of medical personnel and a sub-optimal organisation of the institution.

Clinical audits constitute a proven method of identifying and minimising unjustified examinations and treatments with ionising radiation as well as optimising processes and resources. They do not involve monitoring technical quality assurance or an inspection by the supervisory authorities, but rather a peer review, in which representatives of the involved professional societies review the work processes of their colleagues with regard to good clinical practice.

The concept of clinical audits was already incorporated into law by the European Commission in 1997. In the most recent EURATOM directives, all member states are required to carry out clinical audits in accordance with national procedures by 2018. Implementation has varied widely between the member states until now. The greatest progress has been made in Finland, where all radiology centres have been audited repeatedly. Although not a member of EURATOM, Switzerland is also committed to implementing its guidelines.

In Switzerland, the average radiation exposure of the population due to medical applications increased by 40% between 1998 and 2013 [1,2] and currently constitutes about 30% of the mean overall annual radiation exposure. This increase is mainly due to the massive increase in CT scanners and the number of examinations that are performed. In 1994 there were only 136 CT scanners in operation; in 2014 there were already 296. Although only 10% of all diagnostic radiographic procedures carried out in Switzerland are CT examinations, these are causing about 72% of the cumulative annual radiation dose [2]. Significant increases were also observed in other applications using high doses: the number of PET/CT systems increased from 3 to 30 between 1994 and 2014 and the number of accelerators used in radiotherapy increased from 47 to 71 between 2006 and 2014.

In future, clinical audits should be carried out also in Switzerland in order to minimise the number of unjustified examinations and treatments and to steadily increase the quality and outcomes of patient care. Hospitals and institutions that carry out examinations and treatments with diagnostic computed tomography, interventional radiology, nuclear medicine or radiotherapy should be audited.

Prior to a clinical audit, medical physicists, physicians and radiographers will define the key issues and determine the exact content. During the audit again medical physicists, physicians and radiographers will evaluate the practice of their colleagues on site, and give them recommendations on how to improve their clinical practice where appropriate. An important basis for the audit is the quality manual, which is prepared by the institution to be audited beforehand. It should include the responsibilities of personnel in the institution and training of personnel in radiation protection as well as documentation of radiation doses and the treatment protocols used.

In the past, technical audits of primary care practices by the FOPH have shown that there are differences in the quality of the referral practice and a need for referral guidelines in many places. These help the referring physician to select the most appropriate imaging procedure for a particular problem. In order to ensure that the quality of referrals is high throughout Switzerland, it is envisaged that hospitals, radiology departments and external referring physicians will be aware of the referral guidelines and that they will use them. Since treatments and examinations are often prescribed outside the audited institution, the institution's quality manual should document which referral guidelines are to be used by the external referring physicians and describe how they are handled.

In order to implement clinical audits in Switzerland, the FOPH has established an interdisciplinary expert group consisting of representatives of the relevant professional societies including the SSRMP. In the setting of several workshops, this group has developed a plan for the implementation of clinical audits. In addition, it was drafting a legal text which is now included into the revised Swiss ordinance on radioprotection.

Pilot audits are currently in preparation in the areas of radiology, radiation oncology and nuclear medicine. In each field a working group of medical physicists, physicians and radiographers was therefore established. These groups have recently developed checklists and requirements for the quality manuals. In the field of radiology the current focus is on procedures and processes of CT examinations, in nuclear medicine it is on procedures and processes of PET-CT examinations, and in radiation oncology the whole patient pathway is to be audited. To ensure that the quality of the pilot audits corresponds to international standards, audit contents are currently being evaluated by European experts from different fields. Several medical physicist and other specialists have already been trained as "external auditors", and different hospitals have confirmed their voluntary participation in the pilot audits. The first audits are planned for the second half of this year. After the pilot phase the results will be analysed and the audit contents will be reviewed and adapted. In addition, the time expenditure and cost of future clinical audits will be estimated, based on experiences from the pilot audits. It is envisaged that the first official clinical audits will be carried out in 2017 after the planned entry into force of the revised Swiss ordinance on radioprotection.

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Michael Gasser, Bundesamt für Gesundheit BAG

Report on MedAustron visit

13 April 2015

This contribution came from a visit to MedAustron kindly offered by Barbara Knäusl, PhD, Post-Doc in the Christian Doppler Laboratory for Medical Radiation Physics and Medical Physicist at the Medical University of Vienna (www.meduniwien.ac.at/radonc), Dr. Markus Stock Deputy Head of Medical Physics at EBG MedAustron GmbH and Thomas Schreiner, CEO of the non-clinical research part PEG MedAustron GmbH.

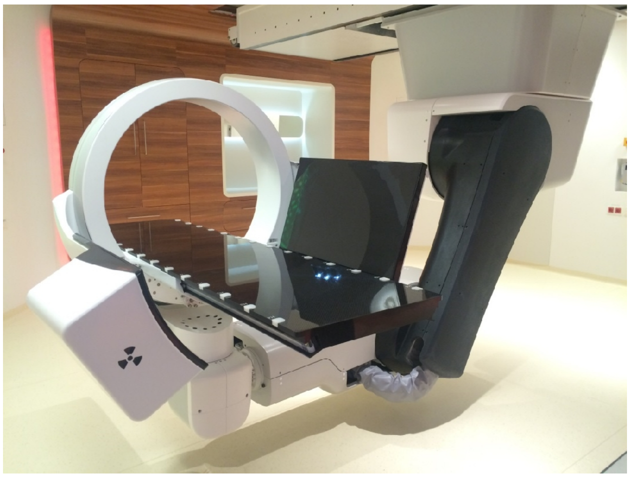
The MedAustron facility is located in the city of Wiener Neustadt, 50 km south of Vienna.

Short overview of the organization

MedAustron is organized in 2 separate groups ->

I) A non-clinical research group (PEG MedAustron – GmbH, Thomas Schreiner): mainly uses protons (p) and light ions; the equipment includes several chemical and biological laboratories, dosimetric equipment, a software laboratory for treatment planning purposes and, as main component, the non-clinical irradiation room (IR1).

II) The clinical medical physics team (EBG MedAustron – GmbH, Markus Stock): uses p and C-ions for treatments in 3 different treatment rooms: IR2 with both a horizontal and a vertical beam line for p and C-ions, IR3 with a horizontal beam line also for both particle species and IR4 with a 180 deg. proton gantry.



Patient Alignment Imaging Ring in IR2

What's going on?

The synchrotron is used for p and C-ions acceleration. Protons can be accelerated up to 800 MeV for non-clinical research purposes (IR1), whereas the beam energy for radiotherapy ranges from 60 to 250 MeV (3-38 cm Water Equivalent Range) with 255 discrete energy steps of 1 mm up to 19 cm depth, and of 2 mm below 19 cm. C-ions are accelerated between 120-400 MeV/u (3-28 cm WER) with 251 discrete energy steps of 1 mm. The maximum field size for the fixed beam lines (IR1, IR2 and IR3) is 20x20 cm2, and it's 20x12 cm2 in the proton gantry (IR4).

View of the synchrotron in MedAustron

The ion sources are actually 3, one for protons, one for C-ions and one is a backup source. They are located (main difference with respect to the synchrotron at CNAO) outside the synchrotron. This allows the advantage of entering the injection room and eventually to “play around the sources” when necessary even when the synchrotron is in operation. The injector provides 7 MeV/u before the particles enter the synchrotron. Then, intensity currents up to 10^10 p/spill are achievable for protons and up to 4x10^8 p/spill for C-ions (Spill length=1-10 s).

The dose delivery system comprises of two scanning dipole magnets, ripple filters for increasing the sharpness of the C-ion Bragg Peak (PMMA, 2mm thickness, 23x22cm2 triangular structure) and a range shifter that can be moved in and out for energy degradation in case of very superficial tumors (PMMA, 3cm thickness, 27x27cm2).

Research ...

There are 3 main research groups:

1. Medical Radiation Physics with Specialisation in Ion-Therapy headed by Prof. Dr. Lembit Sihver (TU Wien);

2. Medical Radiation Physics and Oncotechnology headed by Prof. Dr. Dietmar Georg (Medical University of Wien);

3. Applied and Translational Radiation Biology headed by Prof Dr. Wolfgang Dorr (Medical University of Vienna).

…and clinical side!

The treatment planning system is provided by RaySearch (adapted to protons), whereas the imaging ring and all modules connected to that, are provided by RadArt (Salzburg, Austria) and they have been implemented in the RaySearch system.

Especially, the Collision Avoidance System (RadArt) is very interesting: some avatars have been created based on standard human female and male models. These avatars are then specifically modified for each patient, according to two parameters: the patient's weight and patient's height. Finally the CT data from the planning CT are used to reconstruct the patient surface which is then matched to the corresponding avatar. In this way a dummy run of the treatment can be performed on the software to check that no collisions can occur during the treatment.

Actual state of the art

The idea is to start with "only" proton treatments (I>10^9 p/spill) and using "only" the horizontal beam lines in IR3 and IR2 (first beam measurements were performed in IR3 in November 2014).The first patient is scheduled for June 2016.

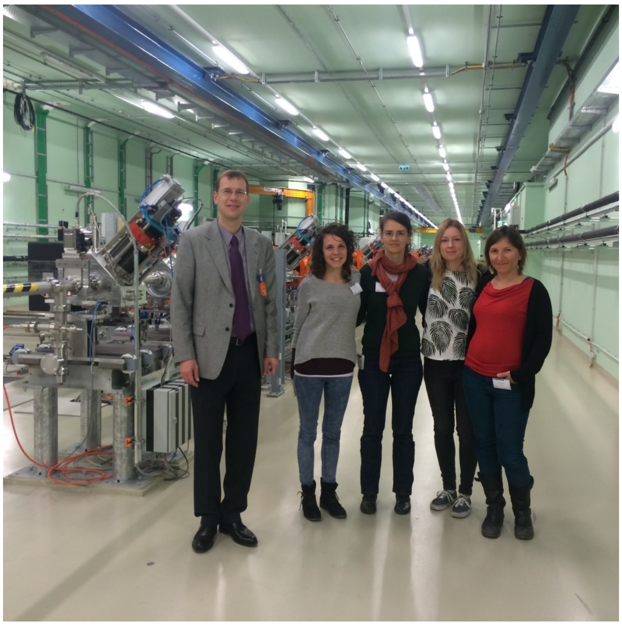
The second step will be the commissioning of the C-ions beam line and of the vertical beam line in IR2.

The third and last step will be the commissioning of the proton gantry in IR4 (gantry is foreseen to become operational in 2019).

As concerns the research infrastructures, the active commissioning and equipment testing, carried out by the research groups of the Medical University of Vienna and the Technical University, has started in January 2015.The first beam-time for non-clinical research is foreseen for the middle of 2016.

So, work in progress and a long list of "to do things"!

Nevertheless … this great team was able to find some time to give us presentations about the MedAustron project (offering tasty biscuits, juices and coffee), to offer us an interesting and fascinating tour through the entire structure … and the cherry above the cake! They let us in the synchrotron! (we were super lucky since for some reasons the activity was stopped just on that day!)



Francesca Belosi, PSI

Report on 2015 ESTRO Particle Therapy Course

March 08-12, Paris, France

The teaching course about "Clinical Particle Therapy" was organised by the ESTRO society and took place in Paris, France in the beginning of March with Eugen Hug and Oliver Jäkel as course directors. The particle therapy course is one of the best-attended teaching courses of the ESTRO society; almost 100 participants came to Paris to learn about the latest developments as well as about the clinical applications and challenges of particle beam therapy. Half of the attendees were medical doctors and the other half came from the medical physics field. The age and the grade of professional experience varied enormously in between the participants. Some of them were PhD students in their starting phase as well as medical doctors in training while also experienced medical doctors and physicists that may change from traditional RT to particle therapy attended the course.

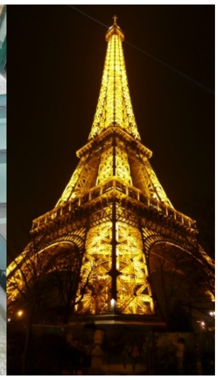
The course started on a wonderful sunny Sunday in the Institute Curie in the middle of Paris close to the Pantheon and the Jardin du Luxemburg. Even if it was a little bit a hustle to find the right entrance in this huge research institute it was a very convenient location for such an event. The local organisation by the team from Orsay with Alejandro Mazal did a great job in finding a comfortable conference room for so many people that conveyed still a familiar atmosphere. The project manager Carolina Goradesky helped us with every kind of problem and question during the whole course while having always a warm smile for us. Coffee and lunch breaks took place in a tent in the patio of the institute where the attendees could also enjoy some of the first rays of sunshine in this year.

On the first evening at the welcome reception participants could get to know each other while having a delicious glass of French wine. On this particular evening I and my colleagues got also the possibility to go for traditional crepes dinner with some of the teachers to refresh existing acquaintanceship, meet new people and exchange news on personal and professional level.

The course itself was well-structured while sessions on medical topics, physics and radiation biology alternated each other with a little bit more lectures focused on oncological topics than on physics. Once there were parallel physics and medical sessions for half a day. Anthony Lomax and Oliver Jäkel motivated a good discussion in the physics session after presenting the latest results on quality assurance, commissioning, in vivo range verification, basic dosimetry and the latest technological developments. Since there were quite many participants, the course was not that interactive as other ESTRO teaching courses I visited. Nevertheless I had the impression that the attendees dared to ask their questions after and during the talks so that everyone could profit from the course. To include the audience more into the discussion a kind of journal club was organised while I was asked to present a paper about LET painting that was followed by a very critical and fruitful discussion of the participants and the teachers.

On the second day everyone was invited to the social event that included a boat trip on the Seine followed by a dinner in a traditional restaurant with view on the Eifel tower. It was a great occasion to meet new people, get in contact with colleagues from other countries and professions and enjoy the beautiful city of Paris.

On the second to last day the whole group was invited to visit the proton facility in Orsay. It was very impressive to see how the team managed to combine the infrastructure of a research-only facility with modern particle therapy equipment. Our group was very welcome by the local team that gave a very informative tour through the whole facility.

Summarizing I greatly enjoyed the days in Paris, especially because many questions I had were answered during the course and I established new friendships that enlarged my network in the particle therapy society. I had a very good overall impression of the teaching course and I would even support the idea to organize in the future two particle therapy teaching courses in order to reduce the number of participants a little bit. I got new input concerning research projects and answers to daily clinical questions therefore I can recommend the course to everyone either working in research or as medical physicist in an upcoming or existing particle facility.

Barbara Knäusl (Medical University of Vienna and MedAustron GmbH Wiener Neustadt)

Recommendations of the Regional Meeting on Medical Physics in Europe: Current Status and Future Perspectives

7 - 8 May 2015, IAEA, Vienna, Austria

The Regional Meeting on Medical Physics in Europe: Current Status and Future Perspectives, held at IAEA headquarters, Vienna, from 7 to 8 May 2015, noted the following:

1. The important contributions of ionising radiation in diagnostic and therapeutic applications in healthcare;
2. The key role of clinically qualified medical physicists (CQMPs)[1] in the safe and effective use of ionizing radiation in medicine (diagnostic and interventional radiology, radiation oncology, and nuclear medicine);
3. The continuous innovations in medical radiation technologies and techniques for imaging and therapy that require comprehensive quality assurance (QA) programmes conducted by CQMPs in order to ensure the quality of diagnostic imaging and radiation treatment of patients;
4. The importance of the role of CQMPs in optimizing radiation protection and safety (of patients, staff and general public) in medical uses of radiation;
5. The shortage of CQMPs in the majority of Member States in the Europe Region;
6. An insufficient harmonization of medical physics education and training among the Member States in the Europe Region;
7. A lack of accredited clinical training programmes and corresponding continuous professional development (CPD) schemes in the majority of Member States in the Europe Region;
8. The efforts carried out by the IAEA, the European Commission and professional organizations to harmonize the core curriculum for medical physics education and clinical training.

The Meeting also observed the following for the Europe Region:

1. National mechanisms for the implementation of international basic safety standards and guidelines on what comprises the medical physics profession[2] are needed and, where appropriate, it is necessary to implement European directives in national legislation;
2. Sufficient levels of CQMP staffing, in line with international recommendations, are of major importance if high quality radiation health care services are to be ensured, and the risk of radiological incidents and accidents reduced;
3. A high level educational and clinical training framework for the certification of CQMPs in the different fields of specialisation (diagnostic and interventional radiology, radiation oncology, and nuclear medicine) is needed;
4. A competent national body for registration of CQMPs should be designated;
5. Adequate mechanisms to deal with the transition period for recognition and certification of senior professionals who are already employed in the field of medical physics should be established;
6. The recognition of medical physics as a health profession is crucial and should be reflected at the national level (list of recognized professions, legal and fiscal environment, etc.), as

well as at the local level within clinical teams and through close involvement in hospital governance boards.

Recommendations for the Europe Region

Recalling the provisions of *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards* (General Safety Requirements Part 3, IAEA 2014) regarding the role of medical physicists in ensuring safety in diagnostic and therapeutic procedures involving the application of ionizing radiation, the Meeting recommended that Member States of the Europe Region should fully recognize the Clinically Qualified Medical Physicist (CQMP) as a health professional with specialist education and training in the concepts and techniques of applying physics in medicine, and competent to practice independently in one or more of the subfields (specialties) of medical physics.

The Meeting also recommended that Member States of the Europe Region should, in particular:

1. **Recognize** medical physics as an independent profession in health care with radiation protection responsibilities, as given in the *Joint position statement by the IAEA and WHO - Bonn Call for Action;*
2. **Ensure** that medical physics aspects of therapeutic and diagnostic procedures, including patient and equipment related tasks and activities, are performed by CQMPs or under their supervision;
3. **Establish** an appropriate qualification framework for CQMPs including education, specialized clinical training, certification, registration and continuing professional development in the specialization of medical physics, i.e. diagnostic and interventional radiology, radiation oncology, and nuclear medicine;
4. **Follow and fulfill** international recommendations regarding staffing levels in the field of medical physics;
5. **Establish** mechanisms for the integration of medical physics services in all centres practising radiation medicine, and establish, where appropriate, independent Medical Physics Departments in which accredited clinical training can take place;
6. **Promote** involvement of CQMPs in hospital governance boards and relevant national health committees;
7. **Establish and enforce** the legislative and regulatory requirements related to radiation safety in medical imaging and therapy where medical physics is concerned, in accordance with international and, where applicable, European basic safety standards.

[1] The term 'clinically qualified medical physicist' as defined in *Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists,* IAEA Human Health Series No. 25 (IAEA, 2013), corresponds to 'qualified expert in medical physics' defined in the *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards,* General Safety Requirements Part 3 (IAEA, 2014), and the 'medical physics expert' defined by the European Council Directive 2013/59/Euratom.

[2] The following standards and recommendations are referred to: *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards,* General Safety Requirements Part 3 (IAEA, 2014); European Council Directive 2013/59/Euratom; *Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists,* IAEA Human Health Series No. 25 (IAEA, 2013); *European Guidelines on Medical Physics Expert*, Radiation Protection No 174 (European Commission, 2014).

Job satisfaction levels in UK radiotherapy centres: radiography and physics workforce

MANAGEMENT

Staff work–life balance can be impacted by workload pressures such as evening, weekend and bank holiday working. Employers need to give consideration to the Flexible Working Regulations effective from April 2014.

Increased provision and appropriate interventions are required to achieve the aim of delivering world-class radiotherapy. Retaining and developing an adequate resourced, skilled and committed workforce will be a key factor in future success.

The UK Francis report (2013) highlighted the tragic consequences of systems failure coupled with health professionals suffering from the effects of compassion fatigue.

Healthcare is hugely rewarding, and paradoxically emotionally strenuous. The combination of associated individual, interpersonal and organisational challenges are primary drivers for burnout. The subsequent Berwick report (2013) highlighted that good people can fail to meet patients' needs when their working conditions do not provide them with the conditions for success. A strong relationship exists between employee satisfaction and patients' perceptions of the quality of their care. Organisations and leaders can significantly influence an individual's satisfaction.

Obtaining an understanding of the work experiences of radiotherapy professionals will support the development of strategies to increase job satisfaction, productivity and effectiveness. In this recently published work, a quantitative survey was conducted assessing job satisfaction, attitudes to incident reporting, stress and burnout, opportunities for professional development, workload, retention and turnover. All questions were taken from validated instruments or adapted from the UK NHS survey.

The survey yielded 658 completed responses (16 percent response rate), from the public and private sectors (see table 1).

Responses were received from 74 of the 75 sites (NHS and private providers) delivering radiotherapy in the UK. Over a third of respondents were classified as satisfied for job satisfaction with 11 per cent dissatisfied and the remaining 53 per cent ambivalent. A significant proportion of clinical staff (38 per cent) reported high emotional exhaustion and low professional accomplishment. Presenteeism was an issue with 42 percent attending work despite feeling unable to fulfill their role. A significant proportion (42 percent of respondents) felt they didn't get the recognition they deserved for doing a good job. A statistically significant difference was also evident between departments. In the non-clinical group over a quarter of respondents reported high levels of cynicism. The majority of respondents stated an increase in the intensity and pace of work in the past 12 months. The increase was attributed to a combination of factors such as staffing levels, lack of resources and administrative support.

Significant workload was frequently preventing staff from undertaking learning and development opportunities.

Professional group	Respondents	Response rate of population (%)
Clinical scientist	201	39.1
Engineer/technician	59	29.2
Trainee clinical scientist	31	25.8
Therapeutic radiographer	315	14.2
Dosimetrist	42	11.3
Trainee assistant practitioners/assistant practitioners	3	3.5
Total (that submitted profession)	651	16.0

JSS Facet	Cronbach's co-efficient α[a]	UK radiotherapy workforce $n = 659$		r^2 with JSS total	US nurse (comparative norm) $n = 664$	
		Mean	SD		Mean	SD
Pay	0.75	12.84	4.52	0.412	12.8	2.9
Promotion	0.73	12.46	4.47	0.499	11.9☹	2.1
Supervision	0.82	☺18.46	4.78	0.448	☺17.9	2.0
Fringe benefits	0.73	13.10	2.73	0.120	14.1	3.3
Contingent rewards	0.76	13.94	4.38	0.685	13.7	2.3
Operating conditions	0.62	12.50	3.53	0.276	12.4	3.2
Coworkers	0.6	☺17.46	3.77	0.472	☺17.8	1.1
Nature of work	0.78	☺19.91	3.63	0.386	☺19.2	1.5
Communication	0.71	14.68	4.25	0.521	14.9	1.6
JSS total	0.91	135.56	23.80	1.000	134.4	12.2

[a]From Spector.[36]
SD, standard deviation

Scoring key	Dissatisfaction☹	Ambivalent	☺Satisfaction
36-item JSS total	36–108	108–144	144–216
4-item individual facets	4–12	12–16	16–24

TABLE 1 [TOP LEFT]:

Response by professional group

TABLE 2 [BOTTOM LEFT]:
Job satisfaction survey (JSS) data with scoring key compared with a comparative norm of nurses

All tables kindly supplied by Daniel Hutton, The Clatterbridge Cancer Centre, NHS Foundation Trust, England, UK. © The British Institute of Radiology 2014.
Hutton D, Beardmore C, Patel I, Massey J, Wong H, Probst H. Audit of the job satisfaction levels of the UK radiography and physics workforce in UK radiotherapy centres 2012. *Brit J Radiol* 2014; 83: 20130742

National targets were cited as impacting on workload, particularly the managers, e.g. the radiotherapy dataset, Trust and national waiting time standards (see tables 2 and 3).

Job satisfaction is multifaceted; it is dependent on the individual, context of work and environment. The remaining facets of supervision, contingent rewards, operating conditions, co-workers, nature of work and communication can be significantly influenced by service leaders and organisations and this is where energy and effort should be focused. Professional development is a key area to focus energy and organizational effort to positively influence job satisfaction. Individuals have a responsibility to themselves and to their colleagues as their behaviours and attitudes influence job satisfaction. Supporting staff and preventing burnout will have a positive effect on absenteeism, team performance and reduce the prevalence and severity of incidents.

Managers and service providers should be encouraged to use existing forums, such as the National Radiotherapy Service managers and the heads of radiotherapy physics network, to discuss and share best practice and enhance learning across organisations. Sharing challenges with the national professional bodies also enables intelligence and evidence to be gained in order to enable these matters to be promoted to key national stakeholders and policy makers. It is recommended that service managers conduct regular local surveys to monitor job satisfaction levels within centres and so highlight and action any local issues to work towards improving job satisfaction levels.

MBI facet under investigation	Classification (%)			Mean	Standard deviation	Comparative norms	
	Low (%)	Moderate (%)	High (%)			Therapy radiographers[a]	Health professionals[b]
Human services (clinical), $n = 367$							
Emotional exhaustion	29.90	32.60	37.50	23.5	11.27	22.9	22.2
Depersonalization	72.10	19.20	8.70	4.9	5.29	7.1	7.1
Personal accomplishment	18.80	26.20	55.00	37.5	7.29	37.0	36.5
General (non-clinical), $n = 280$							
Professional efficacy	28.20	29.30	42.50	26.79	6.11	×	×
General exhaustion	35.60	34.50	29.90	12.62	7.49	×	×
Cynicism	38.20	35.70	26.10	8.67	6.63	×	×

[a]Probst et al,[48] $n = 97$.
[b]Maslach et al,[37] $n = 1104$.

MBI	High	Moderate	Low
Emotional exhaustion	≥27	17–26	0–16
Depersonalization	≥13	7–12	0–6
Personal accomplishment	0–31	32–38	≥39
Professional efficacy	≥30	24–29	0–23
Exhaustion	≥16	8–15	0–7
Cynicism	≥13	6–12	0–5

TABLE 3 [LEFT]: Maslach Burnout Inventory (MBI) human services (clinical) and general (non-clinical) showing percentage of respondents scoring low, moderate and high levels, with scoring key.

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http://www.birpublications.org/doi/full/10.1259/bjr.20130742

[1]Cooper T, Williams MV. Implementation of intensity-modulated radiotherapy: lessons learned and implications for the future. *Clin Oncol* 2012; 24: 539-42.

Sourced from an article that originally appeared in the British Journal of Radiology: Hutton D, Beardmore C, Patel I, Massey J, Wong H, Probst H. Audit of the job satisfaction levels of the UK radiography and physics workforce in UK radiotherapy centres 2012. Brit J Radiol 2014; 83: 20130742

Article by Usman I. Lula and Richard Amos reprinted with the permission of Usman Lula, Editor-in-Chief of **IPEM Scope magazine**. Usman Lula is a Principal Clinical Scientist working in radiotherapy physics at the Queen Elizabeth, University Hospitals Birmingham NHS Foundation Trust. His role supports clinical research and development.

http://www.ipem.ac.uk/Publications/SCOPE/ESCOPE.aspx

CALENDAR 2015

9-12 September Marburg, DE	46th Annual Meeting of the German Society for Medical Physics *http://www.dgmp-kongress.de/*
5-9 October Vienna, AT	International Conference on Clinical PET-CT and Molecular Imaging IPET 2015 *http://eventegg.com/ipet-2015/*
9th October Wiener Neustadt, AT	Annual Meeting of the Austrian Society for Medical Physics *http://www.oegmp2015.at/*
15-17 October Lisbon, PT	Workshop on European Diagnostic Reference Levels for Paediatric Imaging *http://www.eurosafeimaging.org/pidrl/workshop*
21-22 October **Fribourg, CH**	**SSRMP Annual Meeting 2015** *http://physmed.net/SSRMP2015/*
26 Oct.-1 Nov. Archamps, FR	European School of Medical Physics ESMP From 2D to 4D X-ray Imaging for Diagnosis and Treatment *http://www.esi-archamps.eu/Thematic-Schools/ESMP/Courses-in-medical-physics/2.-Diagnostic-and-Interventional-Radiology*
29 Nov.-4 Dec. Chicago, USA	Radiological Society of North America 101st Annual Meeting RSNA 2015 *http://www.rsna.org/Annual_Meeting.aspx*
15-19 February, 2016 **Geneva, CH**	International Conference on Translational Research in Radio-Oncology-Physics for Health in Europe (ICTR-PHE) *https://ictr-phe16.web.cern.ch/*
25-27 August, 2016 **Sursee, CH**	**SASRO 20th Anniversary Meeting** *http://www.sasro.ch/*

And please, if you participate in any conference or meeting, think of writing a few lines or sending a picture for the Bulletin.

THANK YOU!

ON THE MOVE

Nikos Koutsouvelis

Dear colleagues,

I moved to Switzerland in 2011, right after my SFPM graduation (french society of medical physics).

I started my professional career at *Clinique des Grangettes* in Geneva, where I worked for 3,5 years. During this time, I have had the chance to work closely with great colleagues and grow both on a personal and a professional level, facing many responsibilities.

At present, I am very glad to join the highly respected radiation therapy team of the *Hopitaux Universitaires de Geneve*. Being part of such a team grows further one's personality, by sharing and exchanging knowledge with fellow colleagues and senior members, with admirable scientific and human qualities.

I received their very warm welcome on 1st july 2015, and enjoying a very constructive and fruitful collaboration ever since!

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Mauricio Leick

I have studied medical physics in Brazil, graduated in 1995 and after 3 years of a medical physics residency program in the Cancer Center of Sao Paulo I have been board certified in the radiotherapy field.

In 2003 I moved to Greenville, North Carolina to work at East Carolina University as a Research Associate. I have relocated to Europe in 2007 to work as a medical physicist for TomoTherapy BVBA in Brussels (BE) and in 2010 to work for Varian Medical Systems EMEA in Zug (CH) and Helsinki (FI).

Since July 2015 I am working as a medical physicist at the radiotherapy department at Clinique des Grangettes in Genève. In this new position I am working in different fields of clinical routine and scientific activities.

Thanks and best regards,

Mauricio Leick
Medical Physicist
Radiotherapie
Clinique des Grangettes

IMPRESSUM

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Also, you are invited to participate in the construction of our bulletins. Of desirability are all contributions that could be of interest to members of our society, such as

- ✓ Reports of conferences, working group meetings, seminars, etc.
- ✓ Reports on the work of various committees and commissions
- ✓ Succinct results of surveys, comparative measurements etc.
- ✓ Short portraits of individual institutions (E.g. apparatus equipment, priorities of work, etc.)
- ✓ Reports on national and international recommendations
- ✓ Short Press Releases
- ✓ Photos
- ✓ Cartoons & caricatures
- ✓ Announcement of publications (E.g. books, magazines)
- ✓ Announcement of all kinds of events (E.g. conferences, seminars, etc.)
- ✓ Short articles worth reading from newspapers or magazines (if possible in the original)
- ✓ Member updates (E.g. appointments, change of jobs, etc.)

The easiest way to send your document is as a MS Word document via email to one of the editor addresses above.

Deadline for submissions to Bulletin No. 84 (03/2015) : 11.2015

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