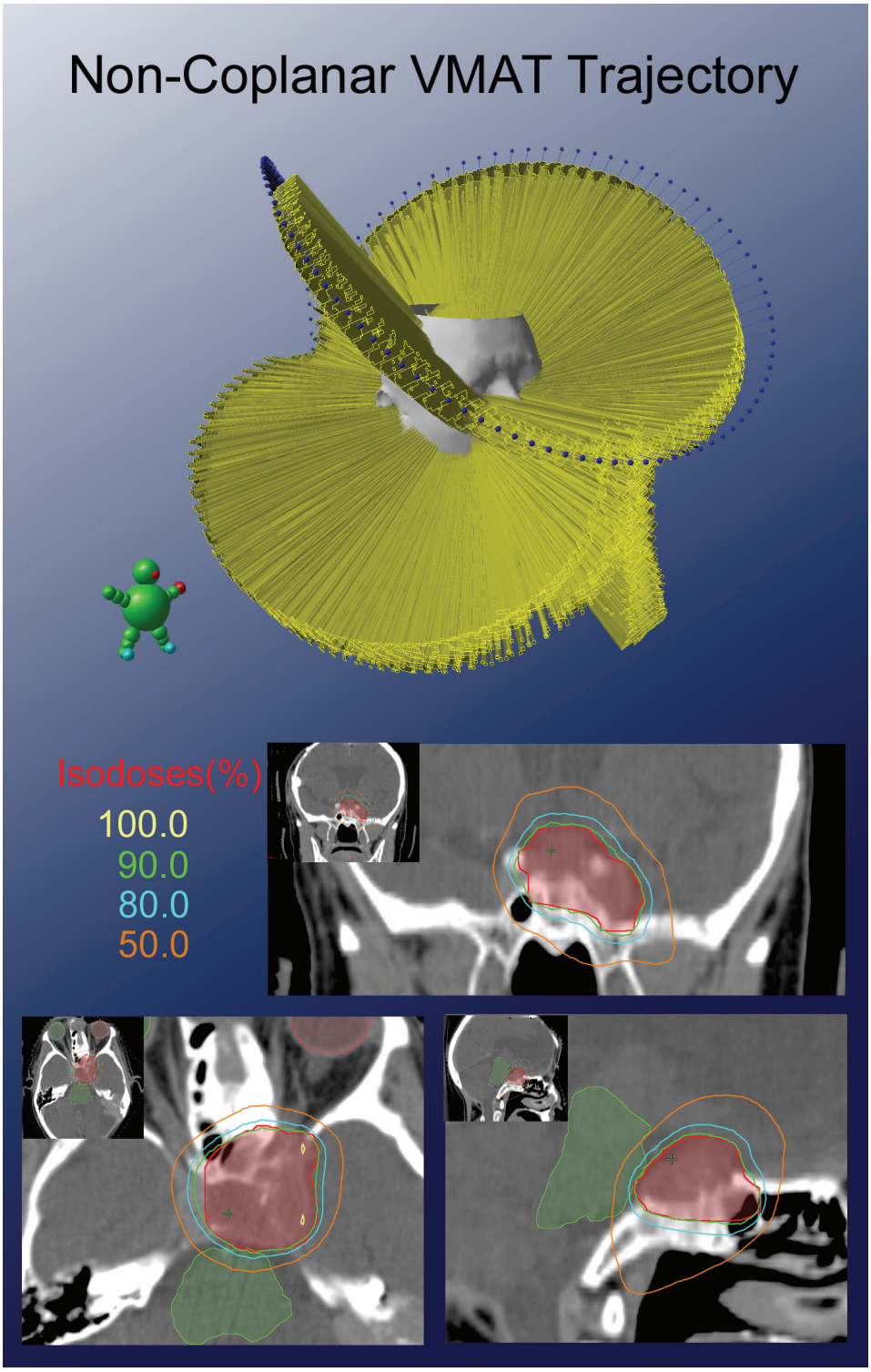
InterACTIONS

CANADIAN MEDICAL PHYSICS NEWSLETTER
Le BULLETIN CANADIEN de PHYSIQUE MÉDICALE



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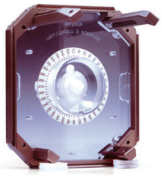
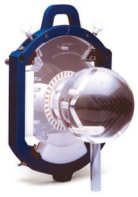
LE COLLÈGE CANADIEN DES PHYSICIENS EN MÉDECINE

54 (4) octobre/October 2008

Tools of the Trade





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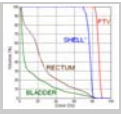
Volume 54, Number 4– octobre/October 2008



Cover Image

Volumetric Modulated Arc Therapy (VMAT) is a novel RT technique where MLC shapes and dose rate are dynamically modulated while the gantry rotates around the patient. Recent improvements in optimization methods have made it possible to achieve highly conformal dose distributions with only a single 360 degree gantry rotation. Treatment delivery times are 2-8 times faster than conventional IMRT methods reducing the likelihood of intrafractional motion, providing more time for on-line verification and allowing clinics to provide highly conformal treatments to more patients. We have extended the VMAT planning algorithms (predecessor to Varian RapidArc™) to non-coplanar source motion defined by gantry angle, couch angle, and couch position. The trajectory is constructed using a series of control points distributed along the source motion path. For planning, continuous source motion is modeled as a series of static beams with one beam defined at each control point. Highly restrictive constraints are placed on MLC and source motion to preserve a continuous, efficient and accurate delivery. Normally these restrictions would also severely limit the ability of the optimization algorithm to derive a high quality plan. This problem is solved using a novel technique for aperture based optimization where a coarse sampling of unrestricted control points is used in the initial stages of optimization. As the optimization progresses additional control points are added with increasing restrictions on MLC and dose rate variations. This approach maintains time efficiency and delivery accuracy while providing the optimization with the high degree of flexibility inherent with a non-coplanar beam geometry. Highly conformal dose distributions may be achieved that are superior to coplanar VMAT deliveries particularly for intracranial Stereotactic Radiosurgery treatments (shown here).

Image provided by Karl Otto, Medical Physics, BC Cancer Agency

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Michelle Cottreau: mjcottreau@ihis.org

Please submit stories in Publisher 98, Word 6.0, Word 97, or ASCII text format. Hardcopy submissions will be scanned to generate an electronic document for inclusion in the Newsletter. Images in Tiff format at 300 dpi resolution are preferred.

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Message from the COMP Chair:

I would like to begin by welcoming **Dr. Peter McGhee** and **Dr. William "Bill" Zeigler** to the COMP Executive. Peter was elected to the role of Chair-Elect at this year's AGM. As many of you know, Peter has been very involved with COMP over the years. It was only last year that he stepped down as Councillor of the Professional Affairs Committee and we are very happy to have him back in this new capacity after such a short break. Bill was elected to the role of Treasurer and will be replacing **Maryse Mondat** in January 2009. Our many thanks to Peter and Bill for volunteering their time. We look forward to working with them in the years to come.

With the successful completion of the 2008 COMP Annual Scientific Meeting I would like to, once again, take this opportunity to thank all the volunteers who worked so hard to make this event such a success. I think that anyone in attendance, delegates and exhibitors alike, will agree that the conference venue and organization were superb. Many kudos to the Local Arrangements Committee for all the hard work they put into this event.

I think that anyone in attendance, delegates and exhibitors alike, will agree that the conference venue and organization were superb...

As always, the highlight of the meeting was the J.R. Cunningham Young Investigators Symposium (YIS). The quality of these presentations (as well as the research involved) is a testament to the high standards we set in Canadian medical physics.

I would like to take this opportunity to personally congratulate the winners of the various awards presented at this year's meeting:

J.R. Cunningham YIS:
1st Place: Karl Bush
2nd Place: Matthew Wronski
3rd Place: Ante Mestrovic

Developing Country Travel Award:
Marija Popovic (Juravinski CC)

Best Poster:
1st Place: S.K. Dhanesar
2nd Place: X. Mei

Best Oral:
1st Place: Q. Tang
(pres. by I. Yeung)
2nd Place: A. Sarfehnia

Sylvia Fedoruk Prize:
M. Bazalova, L Beaulieu, S Palefsky, and F. Verhaegen

I hope that those of you who attended the ASM have taken the time to express your opinions and suggestions about the proceedings by completing the ASM delegates questionnaire. If not, we welcome any comments to the COMP office or myself directly. We look forward to seeing you at the 2009 COMP ASM in Victoria next year.

With the formation of the Science and Education Committee (SEC) we now have a mechanism to develop high quality educational courses and other activities that will promote best practice with the field of medical physics. In addition, the creation of a Students Council that reports to the Executive through the SEC will help promote involvement in COMP by the student population while giving them a voice in setting the direction of medical physics in Canada. This provides a tremendous benefit to the students but we should not forget the greater value that we receive from having access to the fresh ideas and perspectives of this upcoming generation of Medical Physicists. Terms of Reference for the SEC and the Students Council will be forthcoming on the COMP website.

... the creation of a Students Council that reports to the Executive through the SEC will help promote involvement in COMP by the student population while giving them a voice in setting the direction of medical physics in Canada.

Mr. Jason Schella
COMP President

Efforts like these are important steps in the development of the organization as it will provide greater value to our membership and help garner interest in those outside of COMP.

As always, we welcome any help the members of our community can give through volunteering. If you wish to help our organization grow, feel free to contact me at
jason.schella@cdha.nshealth.ca
or Nancy Barrett at
nancy@medphys.ca

Message from the CCPM President:

My congratulations to COMP and the local arrangements committee for the successful annual scientific meeting in Quebec City. Both the science and Quebecois joie de vivre were very enjoyable.

I would like to thank **Narinder Sidhu** for his eight years of service, most of them as Treasurer, on the CCPM board and to welcome **Darcy Mason** who joined the CCPM board at the June CCPM AGM.

I would also like to congratulate this years winner of the Harold E. Johns Travel Award, **Russell Ruo** from McGill, Montreal who intends to travel to the ESTRO Teaching Course on IGRT in Brussels in December.

The award covers travel costs of the recipient for up to $2000 to visit another center or institution. The HEJ fund is not supported by either the CCPM exam fees or your annual COMP dues.

If you read this year's CCPM audited financial statement, which also includes the HEJ financial report, you will notice that this fund is shrinking rather than growing, a situation that I consider embarrassing to the Canadian medical physics profession. Please donate a week's equivalent of your coffee money to the HEJ fund on your upcoming dues renewal. Depending on the "other guy" to donate doesn't work: we barely have 300 members, so unless each one of us chips in $10 the HEJ fund will dry up.

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The CCPM's adoption of the ABR CAMPEP residency requirement that states that an applicant for the ABR board exams in 2014 must be enrolled in or have completed a CAMPEP approved residency was discussed at the CCPM annual general meeting and raised several questions from the membership. Starting with the easy questions first.

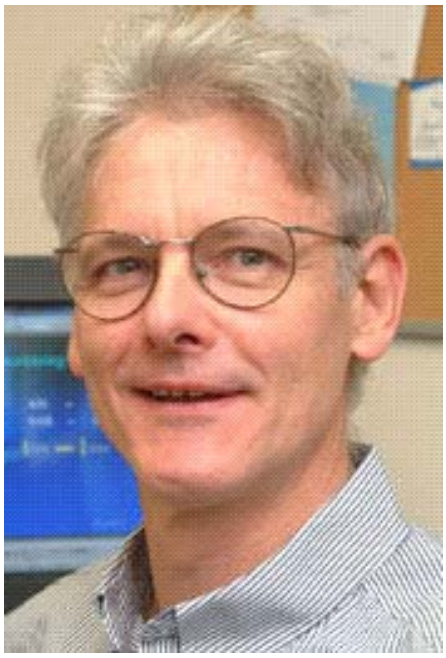
"Should current graduate students be alerted so that they understand the implications if they are not currently enrolled in a CAMPEP approved program?" The answer is yes, but this will require help from the membership via an e-mail response to find not only all the graduate training programs in Canada, but also the appropriate person at each graduate training program through whom this can be communicated.

"Should the COMP website be updated to include information about this issue and which graduate programs are CAMPEP approved?" Yes, and both the COMP and CCPM websites will include this information. And now for the tougher questions.

"Will there be grandfathering?" My interpretation of this is the following: if a non board certified medical physicists has been practicing medical physics for "many" years will that physicist first have to do a two year CAMPEP residency before they can apply to sit the CCPM board certification exams. This will be discussed by the CCPM board and has not been discussed on the ABR website. My personal response, not the official CCPM position, is that if the applicant had already been working as a fully responsible medical physicist by the time that the CAMPEP requirement came into effect they would not be required to go back and do a CAMPEP residency. Bumping a young trainee from a CAMPEP residency spot with a veteran medical physicist is poor policy. There are nuances that need to be clarified, but the philosophy is that a certification board exists to improve professional competency, not to act as a union.

(with respect to CCPM's adoption of ABR CAMPEP residency requirements)
"Will there be grandfathering?" … my personal response... is that if the applicant had already been working as a fully responsible medical physicist by the time that the CAMPEP requirement came into effect they would not be required to go back and do a CAMPEP residency.

The final question: "Do we have to necessarily follow the ABR timelines?" My interpretation is that the questioner was not asking whether the CCPM was going to implement the CAMPEP requirement before 2014 and ahead of the ABR. The answer is yes, but because the ABR exam scheduling and process is different from that of the CCPM, the implementation timelines will not be exactly the same. The CCPM timeline should not create a situation where candidates on either side of the US/Canada border apply for certification to the cross border board in order to side step the CAMPEP requirement.



Dr. Dick Drost,
CCPM President

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Message from the Executive Director of COMP/CCPM:

Annual Scientific Meeting
The feedback regarding the Quebec City ASM was most positive and congratulations are in order for **Luc Beaulieu** and his team. We are also grateful once again to our corporate sponsors for their generous support of the meeting. A summary of the evaluations can be found in a separate article in this issue of the newsletter. Thank you to all those who provided feedback and congratulations to **Martin Shim** of the Juravinski Cancer Centre – who completed the evaluation and was the winner of the $50 Chapters gift certificate.

...feedback regarding the Quebec City ASM was most positive and congratulations are in order for **Luc Beaulieu** and his team.

Your feedback is important and your suggestions will certainly be taken into account for the 2009 Annual Scientific Meeting in Victoria. Preparations are already underway for this meeting to ***mark your calendars for July 21-24th.*** The date has been changed from the original June date to avoid overlap with the AAPM summer school. The conference will be taking place at the Fairmont Empress hotel and the Victoria Conference Centre. This premier downtown venue will enable delegates, family and friends to take advantage of all that the beautiful city of Victoria has to offer.

Your feedback is important and your suggestions will certainly be taken into account for the 2009 Annual Scientific Meeting in Victoria.

Membership Directory
We are working on improving the online directory and are in the process of changing it from being an "opt-in" directory to one in which all members are included.

As well, we are implementing some changes to the printed annual membership directory to reduce the publishing and mailing costs and make the directory more environmentally friendly as less paper will be required. We will continue to include member contact information, COMP Executive, CCPM Board and committee lists, current award winners but will no longer be including the COMP and CCPM bylaws, past award winners and committee terms of reference as this information is available on either the COMP or CCPM website.

... we are implementing some changes to the printed annual membership directory to reduce the publishing and mailing costs and make the directory more environmentally friendly as less paper will be required.

Professional Survey
We were very pleased that 227 full COMP members responded to this year's Professional Survey, a 27 per cent increase from 2006. The results are currently being reviewed by the Professional Affairs committee and a report will be published in the Members-only area of the website and in the January 2009 issue of InterACTIONS.

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Strategic Plan Implementation
Things are moving forward with the Strategic Plan activities. A taskforce has been established to look at membership expansion particularly in Quebec – in the hopes that we can build on the momentum created at the Quebec City Annual Scientific Meeting. As well, the Science and Education Committee has been formed and has some exciting plans with respect to the development of a "Winter School". It is hoped that this new program will be launched in 2009.

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Ms. Nancy Barrett,
COMP/CCPM Executive Director

I look forward to meeting with the COMP Executive and CCPM Board at the annual mid-year meeting in November. These meetings provide an excellent opportunity for our volunteer leaders to discuss how to best serve the medical physics community in Canada.

As always, please feel free to contact me at nancy@medphys.ca or Gisele Kite at admin@medphys.ca at any time with your feedback and suggestions.

CNSC Feedback Forum

Class II Nuclear Facility License Applications and Amendments

Submitted by: Jeff Sandeman & Kavita Murthy
CNSC, Ottawa ON

In order to make sense of how the licensing process works for Class II Nuclear Facilities, one needs to keep in mind some of the powers given to the Canadian Nuclear Safety Commission (CNSC) under the Nuclear Safety and Control Act (NSC Act), as well as the limitations on those powers.

Section 24(1) of the NSC Act empowers the CNSC to, *"... **establish classes of licences** ..."* authorizing the licensee to carry on certain types of activities. These activities are listed in section 26 and include, *"... **construct**, **operate**, modify, **decommission** or abandon a nuclear facility..."* This is the basis for establishing the various types of licences described in sections 3, 4 and 5 of the Class II Nuclear Facilities and Prescribe Equipment Regulations (CII Regs).

The NSC Act also defines exactly what types of actions the CNSC can take with respect to a licence. Section 24(2) identifies these as "... ***issue**, **renew**, suspend in whole or in part, **amend**, **revoke** or replace a licence..."* It also specifies that such actions may be taken *"... **on receipt of an application***.", but section 25 then grants the CNSC the power to renew, suspend, revoke or replace (but not to issue) a licence *"...on its own motion..."*, (i.e., without an application), under certain conditions. These conditions include allowing the licensee an opportunity to be heard, pursuant to section 40 of the Act.

Finally, a licence may contain "... *any term or **condition** that the Commission considers necessary for purpose of the Act ..."* as indicated in section 24(5) of the Act.

Within the scope of this empowerment, the normal Class II Nuclear Facility licensing cycle consists of a series of licences which, upon receipt of acceptable applications, are issued to authorize the construction, commissioning, routine operation and decommissioning of the facility. The content of an application for each type of licence is outlined in document C120, "***RADIATION THERAPY** - LICENCE APPLICATION FORM and GUIDE*". As the facility makes the transition from one phase of licensing to the next, the old licence becomes obsolete and must be revoked. Even for revocation, the preferred route is to have the licensee request the revocation, rather than doing so on the CNSC's own motion, as this would invoke a much more complicated and time consuming process.

Once a licence has been issued, it can be amended at any time, normally upon a request from the licensee. Under normal circumstances, this is the only way a licence is amended, although the CNSC may choose to exercise its power to amend licences on its own motion in exceptional cases. One example of this was the addition of the "Sealed Source Tracking" licence conditions to all relevant licences in 2006.

Conversely, every Class II licence contains conditions which effectively force the licensee to apply for an amendment in order to make any significant change to the design or operation of the facility. For example, the first operating licence issued for any newly installed accelerator, cobalt teletherapy unit, or HDR afterloader, will contain a restriction in section IV)(a) which limits the scope of operation to that which is required for the purposes of commissioning the facility. An application to amend the licence to remove this restriction must then be submitted before routine treatment of patients can commence. The information which must be submitted in order to obtain such an amendment includes radiation dose rate measurements in all areas surrounding the facility, results of safety interlock testing, and operating safety instructions.

Similarly, every Class II licence contains a condition (LC2917) which requires every licensee to:

"... carry out the licensed activities in accordance with the documents or parts thereof referred to in the Appendix: Licence Document(s)."

The equipment specifications, facility design, safety interlock systems, and key operating policies and procedures submitted by licensees as part of their licence applications are included in the referenced Appendix. Consequently, a licensee cannot legally alter any of these key parameters without first notifying the CNSC and requesting an amendment to their licence.

All of this is fairly straightforward under normal circumstances. However, there are a few common situations in which questions arise regarding the type of licence required or the need to apply for a licence amendment.

Q) We have an existing facility that was built many years ago, but now that machine needs replacement. What types of licences do I need to do this and what information must I submit?

First, if this is an accelerator or cobalt teletherapy facility, you must obtain a licence to decommission the facility (see section K of C120). Please note that the requirement to obtain a decommissioning licence for cobalt units has only recently come into force (April 2008) and C120 has not yet been revised to explicitly reflect this change. The decommissioning licence is intended to ensure that all decommissioning work is performed safely by suitably trained persons, and that prescribed equipment and nuclear substances are disposed of appropriately.

Next, if installation of the new equipment necessitates major changes to the shielding design of the facility, (e.g., if additional shielding is required because the new accelerator has a much higher energy, or because of a major shift in isocentre or beam orientation, or if a licensee wishes to remove sections of the room shielding to accommodate a larger make and model of equipment), then you must apply for a licence to construct in order to do the modifications. Otherwise, if the new equipment is essentially the same (or of lower energy) as that previously installed, and is being located such that both the isocentre and beam orientation are the same, you can apply directly for an operating licence to commission the facility.

(Continued on page 128)

CCPM Chief Examiner's Report 2008

Submitted by: Michael Evans
McGill University Hospital, Montreal, QC

Membership Written Examination: This year the written part of the membership examination was held on March 15, 2008 and 34 candidates took this exam - 32 candidates in Radiation Oncology, one in Nuclear Medicine and one in MRI. The examination was held in 13 locations across the country. Out of 34 candidates who took the membership written exam, 31 passed the examination - 29 in Radiation Oncology, one in Nuclear Medicine, one in MRI.

Membership Oral examination: 34 candidates presented for the oral part of the membership exam (31 new candidates and three re-sits). The oral examination for the Radiation Oncology subspecialty was held in Montreal in May, using parallel sessions and 16 examiners (one exam was deferred for medical reasons and held in August in Montreal). The Nuclear Medicine and MRI oral exams were held in Toronto using a panel format and three examiners. All 34 candidates passed the oral examination.

The successful candidates for this year's MCCPM examination were:

Agapito, John	Albaret, Claude	Angers, Crystal
Ayers, Rex	Badragan, Iulian	Barnett, Erin
Belliveau-Nadeau, Dominic	Benelfassi, Ahmed	Borg, Jette
Boudreau, Chantal	Brown, Derek	Buckley, Lesley
Cao, Fred	Chang, Zhang	Diamond, Kevin-Ross
Drever, Laura	Dysart, Jonathan	Gagne, Isabelle
Goertzen, Andrew	Huang, Vicky	Hudson, Alana
Newcomb, Chris	Niedbala, Gosia	Pomerleau-Dalcourt,Natalie
Popescu, Tony	Sattarivand, Mike	Seuntjens, Jan
Soisson, Emilie	Studinski, Ryan	Venkataraman, Sankar
Wu, Huanjin	Yahya, Atiyah	Zhang, BeiBei
Zhang, Susan		

Fellowship Exam: The FCCPM exams were held in Quebec City in June. Nine candidates took the fellowship exam this year; eight in Radiation Oncology and one in Nuclear Medicine. Six candidates passed the exam (five in Radiation Oncology and one in Nuclear Medicine). The successful candidates were:

Colin Field, Marc MacKenzie, Geordi Pang, James Robar, Raxa Sankreacha and Glenn Wells.

On behalf of the CCPM I would like to congratulate all new Members and Fellows.

Finally, I would like to point out the tremendous level of support I have received from the Board and the CCPM community at large in running this exam. Whenever I have asked for help it has always been forthcoming, and the strength and success of the CCPM is a reflection of the commitment of its members. In particular I would like to thank the following people that helped out either as invigilators, with logistical support, on the exam committee , the marking committee, the appeals committee, as MCCPM oral examiners, as FCCPM oral examiners and fellow Board members (apologies if I missed anyone): Robert Corns, Sherry Connors, Marc Mackenzie, Ian Kay, Jeff Bews, Jeff Richer, John Schreiner, Tom Farrell, Peter O'Brien, Milton Woo, Katharina Sixel, Konrad Leszczynski, David Wilkins, Brenda Clark, Horacio Patrocinio, Wayne Beckham, Narinder Sidhu, Dick Drost, John Rowlands, Clément Arsenault, Ted Lawrence, John Andrew, Terry Riauka, Ervin Podgorsak, Gord Mawsley, Frank Prato, Rose Lisi, Tatjana Nisic, Micheline Gosselin, Nancy Barrett, Vitali Moiseenko, Chandra Joshi, Slobodan Devic, William Parker, Michael Hale, Craig Lewis, Andrew Kerr, Vic Peters, Francois DeBlois, Rob Barnett, Jean-Pierre Bissonnette, Wamied Abdel-Rahman, Linda Crelinsten, Curtis Caldwell, Jake VanDyk.

Canadian Organization of Medical Physicists
Organisation Canadienne des Physiciens Médicaux

2008 Annual General Meeting
MINUTES

Location: Laval University, Quebec City, PQ
Date: 27 June 2008
Chair: S. Pistorius, Secretary: P. Rapley
Present: 45 members

Meeting called to order by S. Pistorius at 4:40 pm

1. Adoption of the Agenda
Motion to adopt: L. Beaulieu **Carried**

2. Minutes of previous AGM, Toronto, 2007
Motion to adopt: P. O'Brien **Carried**

3. Report of the Chair (S. Pistorius)
Implementation of the three-year Strategic Plan:

- The Science and Education Committee has been established Interim Chair: Marco Carlone
- There was an inaugural meeting of the Students Council
- In order to increase membership a task group has been charged with identifying what we can offer/do to enable us to attract:
  - More Medical Physicists from Quebec
  - Greater number of Imaging/Nuc. Med. Physicists
  - Attract PA's as associate members.
- Finance is being handled through the office of the Executive Director
  - Enable Treasurer to focus on big picture
  - Greater efficiency
- The COMP Website has a new design and layout which has resulted in savings in ongoing costs and increased flexibility. The following features are included with the website:
  - Membership database
  - E-commerce
  - Abstract processing

Expansion of the COMP Executive
The Executive proposes that the Chairs of the Science & Education Committee and the Radiation Safety and Technical Standards Advisory Committee sit on the COMP Executive. This will require a bylaw change which will be proposed for ratification at the 2009 AGM.

Fellow Member Category
It has been proposed that COMP introduce a Fellow membership category. The purpose of this proposed, new membership category is to honour members who have made significant contributions through: service to COMP, advancement of medical physics knowledge, education and leadership. The following guidelines have been suggested:
Fellows must be full members of COMP for 10 years
There would be a limit on the number of Fellows in total and the number awarded each year.

While the concept has the support of the COMP Executive, concern has been expressed by the CCPM Board and other members that using the term "Fellow" will create confusion within the medical physics community as this term is already used by the CCPM. A task group has been established to see if there is a suitable alternative or resolution.

JACMP
COMP is a sponsoring organization of the JACMP and three COMP members serve on the Editorial Board.

4. CCPM President's Report (R. Drost)
6 new Fellows and 33 new Members were welcomed into the College. There are now a total of 169 Members and 116 Fellows of

(Continued on page 95)

(Continued from page 94)

the CCPM
N. Sidhu retired as Secretary-Treasurer and D. Mason has joined the CCPM Board.
Recipient for this year's Harold E. Johns Travel Award is Russell Ruo from McGill, Montreal who intends to travel to the ESTRO Teaching Course on IGRT in Brussels in December.
The award covers travel costs of the recipient for up to $2000 to visit another center or institution.

ABR Summit on CAMPEP Requirements for Board Certification in Radiologic Physics
Beginning in 2012, in order to take the American Board of Radiology Part 1 examination in Radiologic Physics, candidates must be enrolled in or have graduated from a CAMPEP accredited education program (e.g., MS, PhD, or residency). Beginning in 2014, in order to take the American Board of Radiology Part 1 examination in Radiologic Physics, candidates must be enrolled in or have completed a CAMPEP accredited residency program.

Issues to consider:
Raising standards for Medical Physics training
Keeping CCPM recognition in the USA
Lack of sufficient CAMPEP residency positions in Canada
What happens to small residency programs that lack the infrastructure for CAMPEP accreditation?

USA CARE Bill (Consistency, Accuracy, Responsibility, Excellence)
The CARE bill will amend and enforce the Consumer-Patient Radiation Health & Safety Act of 1981 (42 USC 10001, et seq.), and charge the Secretary of the Department of Health & Human Services (HHS) to promulgate updated regulations specifying the education and credentialing requirements for persons who perform medical imaging examinations and who plan and deliver radiation therapy treatments.

Proposed Standards for Medical Physicists:
Masters or doctoral degree from an accredited college or university in physics, medical physics, biophysics, radiological physics, medical health physics or equivalent courses making the applicant board-eligible; two years of supervised clinical practice and board certification by the American Board of Radiology, American Board of Medical Physics, American Board of Science in Nuclear Medicine or Canadian College of Physicists in Medicine.

5. Treasurer's Report (M. Mondat)

The 2007 accounts, audited by Nephin Winter and found to be in good order, were presented.
Motion to accept the 2007 audited statements as presented.
(M. Mondat/J. Van Dyk) **Carried**

Motion to appoint Nephin Winter as auditor for the current year.
(M. Mondat/J. Schella) **Carried**

The 2009 Budget was presented.
Motion to accept the 2009 budget.
(M. Mondat/J. Schella) **Carried**

6. Secretary's Report (P. Rapley)

At the time of the AGM the membership was as follows:

Category	Sept 2007	June 2008	Change
Full	420	437	+17
Associate	11	12	+1
Student	113	94	-19
Retired	6	9	+3
Emeritus	9	8	-1
Corporate	19	21	+2
Totals	**578**	**581**	**+3**

P. Rapley reported that there is an inconsistency regarding membership status for Physics Residents / Junior Physicist who will be expected to join as full members in future applications.
*There were no bylaw changes for consideration. P. Rapley reported that a Bylaws subcommittee (*Secretary, Chair, Past-Chair, Chair-Elect, and Executive Director) *will be formed prior to the midyear executive meetings.*

(Continued on page 96)

(Continued from page 95)

7. Communications Committee Report (M. Cottreau)

The new website has been implemented. While there were some delays with the online dues renewal process, the new website is much easier to maintain, more flexibile with significantly lower ongoing costs. The next challenge is to address the problems with the online membership directory.

M. Cottreau reported that D. Mason will no longer be volunteering on the Communications committee and thanked him for his commitment to the committee. The committee is looking for new volunteers.

A call was made for contributions to *InterActions.*

8. Professional Affairs Committee Report (S. Pistorius for J. Hayward)

The 2008 Professional Survey was sent out electronically to all members. Members were asked to complete the survey by June 20, 2008.

Evidence of Competency: Draft documents have been created for 4 of 7 countries.

Scope of Practice: Construction of the draft document continues.

The PAC is currently reviewing the professional representation of medical physicists with other ancillary organizations. An initial list of current representatives has been developed and a process for appointment of members and reporting strategies is being determined.

9. Radiation Safety & Technical Standards Advisory Committee Report (R. Corns)

A draft revised Terms of Reference has been written. This draft clarifies: Chair responsibilities, committee membership criteria, committee composition, term of office and termination of membership, meeting frequency and quorum, voting

Michael Evans was thanked for his contribution to the Committee over the past five years.

The Committee is working with Peter Raaphorst to draft a standard for bone mineral density.

10. Science and Education Committee (SEC)

The SEC is a new committee and has the following responsibilities:

- To advise the COMP board on scientific matters and to promote and support scientific endeavors that will benefit COMP members.
- To address education and training issues that arise within COMP, including continuing professional development.
- To ensure that the organization meets its strategic aims and objectives in relation to education, and training activities.
- To develop high quality education courses and other activities to promote best practice within the field.
- The SEC is also responsible for supporting the newly formed Student Committee, which will report to the COMP executive through the SEC
- Committee was formed in March 2008
- Committee members have been identified except the Student Council Chair, who will be elected this summer.
- The principle first activity the committee will undertake is the initiation of a "Winter School".
    - This will be a continuing education activity, and will be held in Canada in the winter months.
    - The current working concept is to choose two permanent locations, one in the East, one in the West, and to alternate the location of the school year to year.
    - The first school may be started in 2010.
    - The immediate challenge is to make sure the first few schools are very successful so as to develop a reputation, and to ensure the continued success of the school.
    - Ideas will be solicited from the membership for subjects for the first school.

11. Nominations Committee (P. O'Brien)

Two positions are to be filled:

Treasurer: Two nominations were received and members were invited to vote electronically, by mail, and by fax. Based on the results of the vote, Bill Zeigler was declared elected.

Chair-Elect: Peter McGhee(Thunder Bay Regional Health Sciences Centre) was the only prior nomination. Nominations were called from the floor, and none was received. **Peter McGhee was declared elected.**

Peter O'Brien (2 years as Past-Chair, 2 years as Chair, 2 years as Chair-Elect) was thanked for his service and was acknowledged with a plaque.

(Continued on page 97)

COMP Treasurer's Report 2008 AGM, Quebec QC

Prepared by Maryse Mondat
Hôpital Maisonneuve-Rosemont,

The following is a summary of on the 2007 financial year statements:

1. 2007 statements were audited by Mr. Len Bolton C.G.A. of Nephin & Winter, Chartered Accountants.
2. As of December 31, 2007 the current asset of the organisation stood at $163,767. $15,728 was in our current account, $3,320 in the beanstream account, $11,445 in the conference account.
3. Dues for the 2007 campaign brought in $82761 (Corporate $15278, Full $61988, Student $3820, Associate $655, fee $1020).

CANADIAN ORGANIZATION OF MEDICAL PHYSICISTS

BALANCE SHEET

AS AT DECEMBER 31, 2007

	2007	2006
ASSETS		
CURRENT		
Cash	$ 23,391	$ 64,252
Accounts receivable	8,348	1,366
Investments, at cost	130,116	128,589
Prepaid expense	1,912	1,231
	$ 163,767	$ 195,438
LIABILITIES		
CURRENT		
Accounts payable and accrued liabilities	$ 11,234	$ 23,254
Deferred income	3,300	17,223
	14,534	40,477
SURPLUS		
Accumulated surplus	149,233	154,961
	$ 163,767	$ 195,438

CANADIAN ORGANIZATION OF MEDICAL PHYSICISTS

STATEMENT OF REVENUES AND EXPENDITURES

AND ACCUMULATED SURPLUS

FOR THE YEAR ENDED DECEMBER 31, 2007

	2007	2006
INCOME		
Advertising	$ 37,944	$ 34,724
Scientific meeting	-	90,526
Membership dues	84,434	53,486
Subscriptions	8,836	6,480
Other revenue	2,336	3,477
Interest	4,866	7,716
	138,416	196,409
EXPENDITURES		
Communication committee	42,751	43,732
COMP/CCPM representation	1,183	6,021
Management - services (note 3)	69,500	48,462
Bank charges	3,304	5,395
Strategic planning	-	8,101
Office operation	6,896	11,457
Scientific meeting	-	65,818
Survey	-	3,392
Other	5,203	1,085
Executive and board meetings	3,372	12,162
Professional fees	2,000	2,000
Subscriptions	9,935	8,878
	144,144	216,503
EXCESS OF EXPENDITURES OVER REVENUE	(5,728)	(20,094)
ACCUMULATED SURPLUS, BEGINNING OF YEAR	154,961	175,055
ACCUMULATED SURPLUS, END OF YEAR	$ 149,233	$ 154,961

4. Expenses for web site were of $15386 (includes new Website) and newsletter were $20 203. There was no mid-year meeting for the executive/board ($519 for conference call).
5. ASM 2007 with CARO, they paid expenses for the Gold medal recipient and the Executive director. We are still waiting for the financial outcome from CARO.
6. The revenues for 2007 will be reported to the Canadian Customs and Revenue Agency in 2007, and they will be for all subsequent years.

The following are some of the highlights of the 2009 budget:
1. The 2009 budget includes $1000 for the development of the CCPM website.
2. $1000 is budgeted for the new science and education committee (SEC).

(Continued on page 98)

(Continued from page 96)

12. Executive Director's Report (N. Barrett)

N. Barrett formally introduced Gisele Kite to the group. Gisele provides administrative support to both COMP and the CCPM and is fully bilingual so is able to support both our current and prospective francophone members in French.

The website and many of the back end administrative processes have been changed and AMCES is now handling more of the day to day management of the COMP finances. COMP has been a volunteer organization for many years and now that you have more staff support, sorting out who does what takes time. N. Barrett thanked the members for their patience during this time of transition.

N. Barrett acknowledged the work of the Quebec City LAC and thanked them for putting on an excellent meeting and also thanked the COMP Executive and the committee volunteers for their support and encouraged members who might be interested in volunteering to contact the COMP office.

13. Future Conferences: (S. Pistorius**)**

2009: Victoria, July 21st – 24th
2010: Ottawa
2011: Vancouver, joint meeting with AAPM

14. S. Pistorius handed Chair position to J. Schella

15. Adjournment

Motion: That the 2008 AGM be adjourned.
(J. Schella) **Carried**

Meeting was adjourned at 5:50 pm.

(Continued from page 97)

BUDGET				
Description	**2007**	**2007**	**2008**	**2009**
GENERAL INCOME	**Budget**		**Budget**	**Budget**
Advertising	$30,000	$33,548	$30,000	$35,000
ASM -LAC	$20,000	$0	$25,000	$20,000
Dues	$72,000	$82,761	$75,000	$82,000
Short-Term Interest	$100		$100	$100
GIC		$4,700	$2,000	$3,000
TOTAL INCOME	**$122,100**	**$121,009**	**$132,100**	**$140,100**
OPERATING EXPENSES				
Awards/Support	($4,000)	($200)	($4,000)	($4,000)
Bank Charges	($4,100)	($3,304)	($4,500)	($4,500)
Certified auditor	($1,500)	($2,000)	($2,200)	($2,000)
Committee-Communication				
Operation exp.	($1,000)		($1,000)	($1,000)
Directory	($5,000)	($6,536)	($7,500)	($7,000)
Newsletter	($20,000)	($20,203)	($25,000)	($22,000)
Web site	($12,000)	($10,160)	($2,000)	($2,000)
Committee-PAC				
Operation exp.	($1,600)	($534)	($1,500)	($1,000)
Salary survey + tech. survey	($1,600)		($3,200)	($3,200)
Committee-SEC				($1,000)
Committee-RSTSAC	($1,000)		($1,000)	($1,000)
COMP/CCPM Representation	($5,000)	($1,183)	($5,000)	($5,000)
Corporate Fees	($30)	($30)	($30)	($30)
Discretionary Fund	($1,000)		($1,000)	($1,000)
Executive/Board meetings	($12,000)		($13,500)	($13,500)
AGM		($3,432)		
MidYear		($519)		
Insurance	($5,000)	($4,494)	($5,000)	($5,000)
Management services	($70,000)	($69,500)	($70,000)	($70,000)
Office	($3,000)	($4,108)	($3,500)	($4,000)
Plaques	($200)	($205)	($200)	($200)
Public relations	($1,500)		($1,000)	($1,000)
Society Memberships	($2,000)	($2,224)	($2,000)	($2,000)
TOTAL EXPENSES	**($151,530)**	**($128,632)**	**($153,130)**	**($150,430)**
NET (INCOME - EXPENSES)	**($29,430)**	**($7,623)**	**($21,030)**	**($10,330)**
Accumulated surplus			**$149,233**	**$122,977**
Operating revenue		-$7,623	-$21,030	-$10,330
Website CCPM				-$1,000
New website 2008		-$5,226	-$5,226	
Accumulated surplus end of the year)			**$122,977**	**$111,647**

2008 COMP ASM: Young Investigator's Symposium Top Three Long Abstracts

This year, we are pleased to present the top three abstracts from the 2008 COMP ASM J.R. Cunningham's Young Investigators Symposium. As far as the COMP InterACTIONS newsletter is concerned, this is a "first" in the sense that long abstracts are published in the COMP newsletter. Publishing the abstracts here allows the entire membership, particular COMP members who were unable to attend, to get a sample of the breadth and scope of the scientific works across the country.

1st Place Presentation

Simulated annealing optimization of the pre-target electron beam in Monte Carlo virtual linac models

K. Bush[1], S. Zavgorodni[1,2], W. Beckham[1,2], (1) Department of Physics and Astronomy, University of Victoria, Victoria, BC, (2) Department of Medical Physics, British Columbia Cancer Agency, Victoria, BC

Introduction

The conventional method used for the determination of the pre-target electron beam parameters for a particular MC simulation (as oulined by Sheikh-Bagheri and Rogers (2002)) is to begin with an educated guess of the electron beam energy and full width half maximum (FWHM) and subsequently perform iterative trial and error adjustments of these parameters until acceptable agreement with measured profiles is achieved. Using this method for commissioning a MC model can be laborious, as the time required for simulation of each adjustment is large and achieving the optimal combination of parameters is not guaranteed.

For the Clinac 21EX, the shape of the pre-target electron beam intensity (as been suggested by Sheikh-Bagheri and Rogers (2002)) is commonly assumed to be of perfect Gaussian form. Often, after carefully modeling the accelerator to the best known specifications the accelerator model's output cannot be made to acceptably match measured profiles, especially for the case of large fields.

The purpose of this study is therefore to develop a method for determining the initial parameters of the pre-target electron beam within a Monte Carlo (MC) accelerator model able to produce accurate 18 MV 40x40 cm^2 photon field profiles. To achieve this we have developed a novel method by which the pre-target electron beam intensity distribution can be reverse engineered to accurately reproduce measured dose distributions. The method greatly reduces the time required to commission a MC model and enables the ability to explore potential deviations from perfect Gaussian intensity distributions.

Methods

Our method begins from a cylindrically symmetric mono-energetic pre-target electron beam (radius 0.5 cm) of uniform intensity. This beam is subdivided into annular regions of particle fluence (see Figure 1 (*left*)) for which each region is individually transported through the accelerator head and into a water phantom (Figure 1 (*right*)). The division of the electron beam into sub-regions is accomplished by a BEAMnrc component module (ANNULI), written specifically for this purpose.

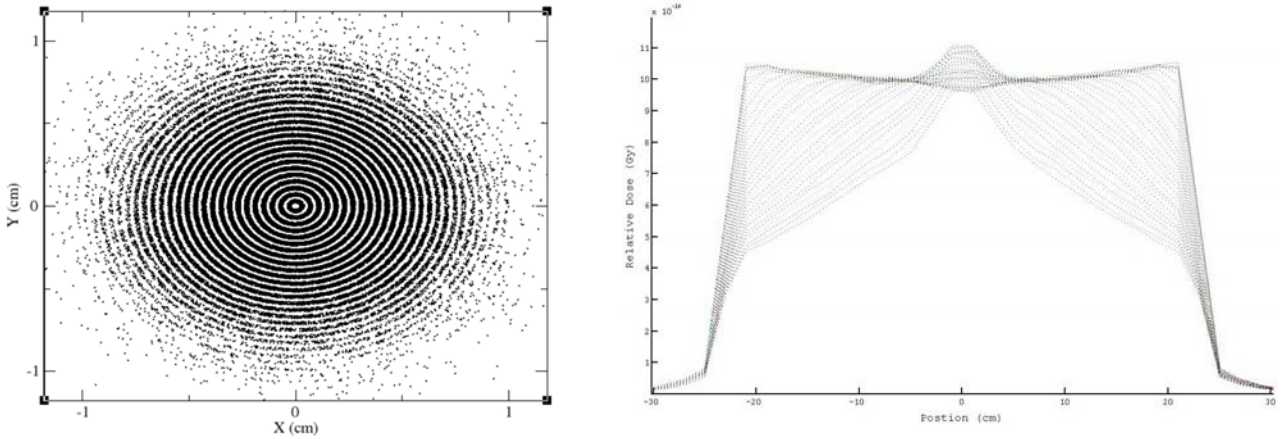

Figure 1: Particle position plot of the pre-target electron beam assigning annular sub regions (*left*). An alternating pattern is displayed for demonstration purposes only. Diagonal dose profiles for a 40 x 40 cm^2 field (in units of dose per incident particle) from 30 annular regions of the pre-target electron beam scored in water at a depth of 3.3 cm (d_{MAX}) are shown on the *right*.

A simulated annealing search is then performed to determine the optimal combination of weights of the annular fluences that provide a best match between measured dose distributions and the weighted sum of annular dose distributions (see Figure 2). At this point it is important to note that a weight change is equivalent to a particle fluence intensity change of the same amount.

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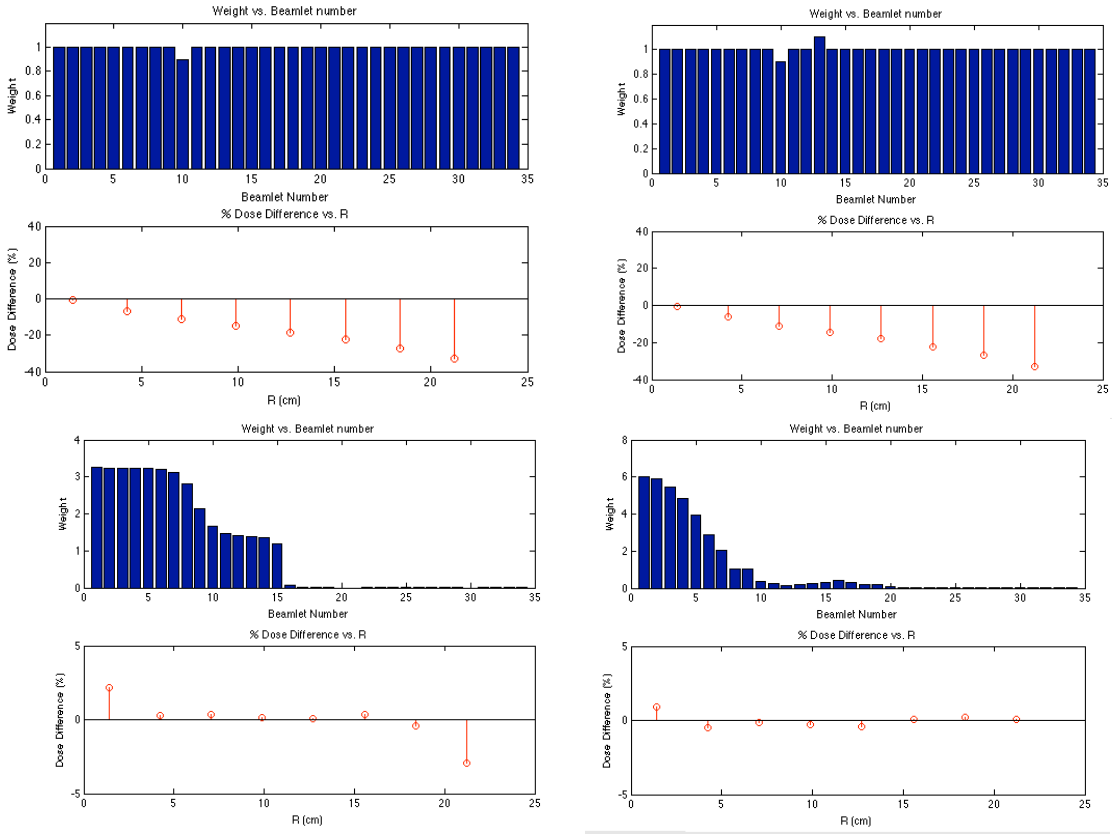

Figure 2: Sample search for the optimal set of annular weights providing best agreement with measurement. For each subfigure the upper bar plot displays the set of annular weights at a given stage of the optimization while the lower figure displays a dose difference plot of the diagonally measured and weighted sum of MC annular dose profiles for a 40 x 40 cm^2 field at a depth of 3.3 cm in water.

The goodness of fit for the simulated annealing search is measured using a chi-squared cost function

$$Cost = \sum_{i=1}^{n} \frac{1}{\sigma^2}[D_i^{MC} - D_i^{Measured}]^2$$

where n is the number of evaluation points, $D_i^{Measured}$ is the measured dose at point i. The weighted sum of MC annular doses is given by

$$D_i^{MC} = \sum_{k=1}^{N}[W_k \bullet D_i^k]$$

where W_k is the weight of annuli N and D_i^k is the dose at point i from annuli k.

Once a global minimum from the simulated annealing search has been found the resulting set of annular intensities must be permanently included in the accelerator head simulation. To achieve this we have written a BEAMnrc component module (RADIALWT) designed to be placed within the accelerator head simulation upstream of the target, within the pre-target electron beam.

Because the electron beam intensity distribution is optimized based on the dose distributions from a 40 x 40 cm^2 field, an assumption was made that the intensity would produce good profile agreement from other field sizes. Verification of the assumption was made through the comparison of 10 x 10 cm^2 and 4 x 4 cm^2 MC profiles and measurement.

Results and Discussion

Remarkably, the intensity distribution converges to a solution that is predominantly Gaussian (as was previously assumed), with a FWHM=1.1mm. In addition, the solution contains an important secondary "extra focal halo" on the order of 10% of the maximum Gaussian intensity. Figure 3 (*left*) shows the resulting optimized pre-target electron beam intensity distribution for 18 MeV electrons with the halo. It is important to note that the optimization was free to assume any form (with the exception of negative weights) and no prior knowledge of the intensity distribution was implied.

(Continued on page 101)

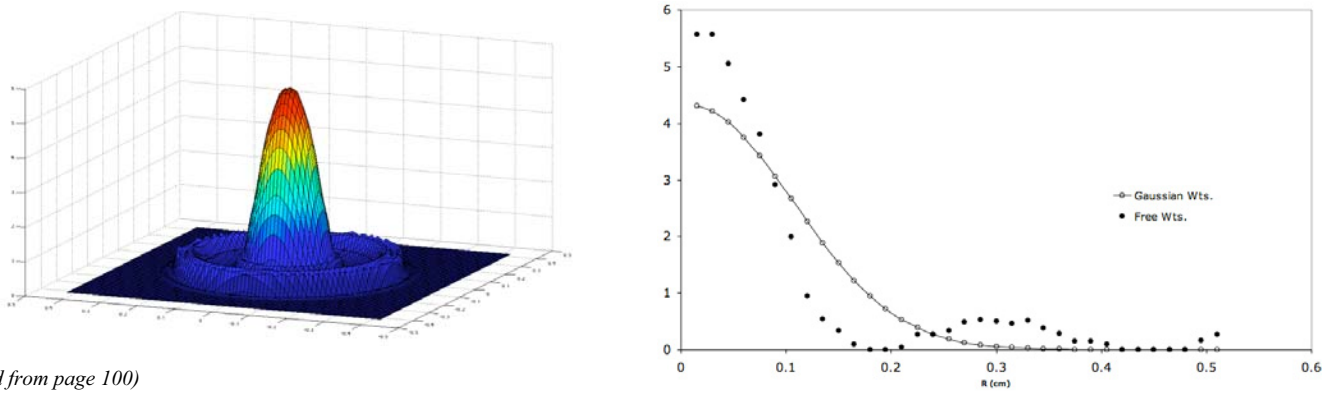

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Figure 3: The optimal pre-target electron beam intensity distribution resulting from the simulated annealing optimization (*left*) and 1-D comparison plot of the free and Gaussian forced optimizations (*right*).

For comparison to a best possible Gaussian pre-target electron beam we repeated the optimization with the additional requirement that the set of annular weights be strictly Gaussian. In Figure 3 (*right*), the best possible Gaussian intensity distribution and free-optimization intensities are shown for comparison.

Diagonal dose profile comparisons from the intensity distributions displayed in Figure 3 are shown in Figure 4 along with diagonal dose profile measurements for a 40 x 40 cm^2 field at 3.3 cm depth. From this plot the importance of including the extra-focal halo is shown.

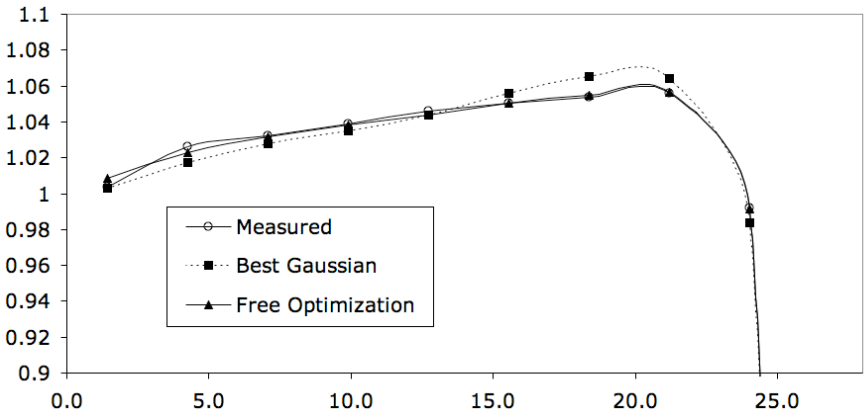

Figure 4: Diagonal dose profiles from a 40 x 40 cm^2 field in water at a depth of 3.3 cm from measurement, and MC dose profiles from a best possible Gaussian intensity, and the resulting intensity from a free optimization of the pre-target electron beam.

Verification of the derived intensity distribution was made for simulations of 10 x 10 cm^2 and 4 x 4 cm^2 field sizes. The resulting cross-plane and depth dose profiles are shown in Figure 5 along with measurement respectively.

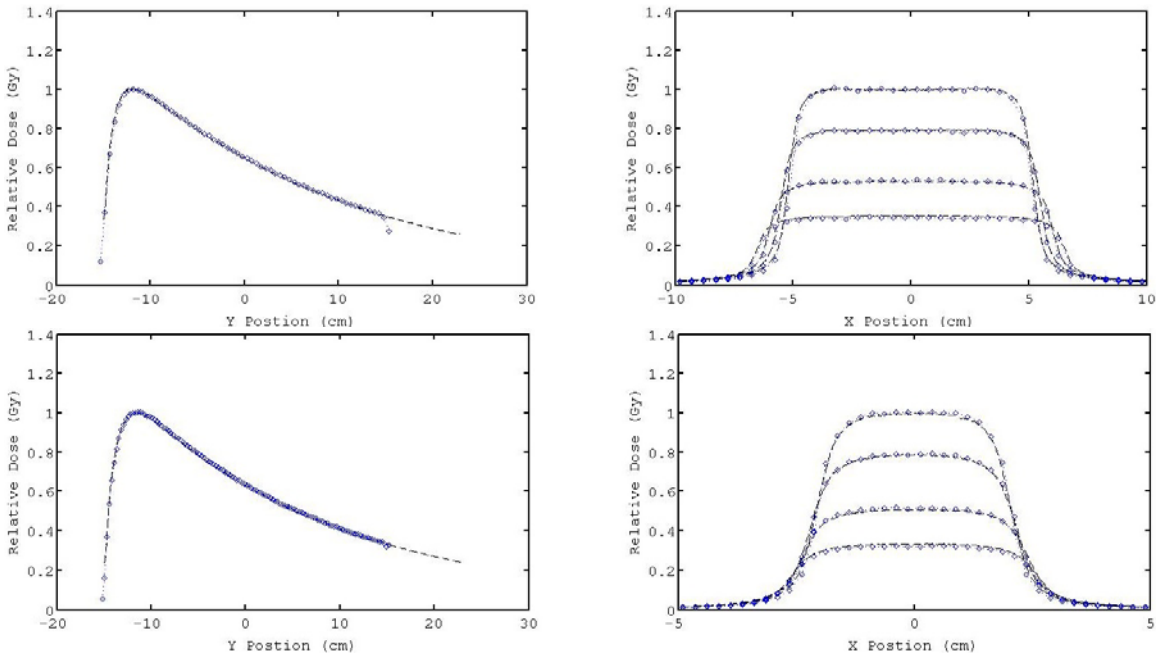

Figure 5: A MC calculated depth dose (*top left*) and cross plane (*top right*) profiles for depths of 3.3 cm, 10.0 cm, 20.0 cm and 30.0 cm from a 10 x 10 cm^2 field using the optimized intensity distribution versus measured dose. A MC calculated depth dose (*bottom left*) and cross plane (*bottom right*) profiles for depths of 3.3 cm, 10.0 cm, 20.0 cm and 30.0 cm from a 4 x 4 cm^2 field versus measurement. In all plots the MC dose is shown in blue and measurement in black.

It is important to note that the energy of the electrons is not at all affected by the optimization. As such it is essential that the incident electron energy be determined accurately prior to optimization. A close approximation of the electron energy is most apparent with ob-

(Continued on page 102)

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taining good agreement of a depth dose profile with measurement. A best guess of the incident electron beam energy may be obtained in the usual way as suggested by Sheikh-Bagheri and Rogers (2002a) by an educated guess followed by iterative trial and error adjustments of the beam's energy.

Conclusions

We have developed a technique to greatly simplify the MC commissioning process while producing dose distributions in better agreement with measurement than previously possible with a Gaussian pre-target electron intensity distribution. The method greatly reduces the effort required to commission a MC accelerator model for clinical use and has achieved better agreement (within 0.5%) with measurement than other methods described in the literature. Further, by implementing a simulated annealing search of the electron beam intensity distribution a guaranteed best fit solution is obtained for a particular incident electron energy.

For our 18MV beam, a Gaussian-like solution was obtained with the presence of an extra-focal halo. The extra focal halo has proven to be an important requirement to achieve the best possible agreement with measurement. It remains to be determined if the halo is a physical effect or simply an indication of a deficiency in the MC model (such as geometry, material types, particle interaction models). However, evidence does support that the effect could be measurable as our derived value of the electron beam FWHM agrees with that measured by Jaffray *et al (*1993), and the "extra focal halo" is in qualitative agreement with measurements made by this group of extra focal radiation (~8% of the output of the accelerator). Jaffray et al were not able to determine an actual shape for the distribution as the measurements were made below the electron target.

Finally, our method is holistic in that no fudge factors, energy/intensity correction functions or unjustified alterations of the geometric MC model are introduced. Results in good agreement with measurement are simply achieved through derivation of the ideal initial conditions of the MC model.

References: D Sheikh-Bagheri, DW Rogers, "Sensitivity of megavoltage photon beam Monte Carlo simulations to electron beam and other parameters," Med. Phys. 29, 379-90 (2002).
DA Jaffray, JJ Battista, A Fenster, P Munro, "X-ray sources of medical linear accelerators: focal and extra-focal radiation," Med. Phys. 20, 1417-27 (1993).

2nd Place Presentation

Development of a Flat Panel Detector with Avalanche Gain for Low-Dose X-Ray Imaging

M.M. Wronski[1], A. Reznik[1], J.A. Rowlands[1], W. Zhao[2], J.A. Segui[2], (1) Imaging Research, Sunnybrook Health Sciences Centre, Toronto, ON, (2) Department of Radiology, Health Sciences Center, State University of New York at Stony Brook, Stony Brook, NY, USA

Introduction

A number of medical procedures such as cardiac catheterization and angiography are routinely performed using X-ray fluoroscopy. Semiconductor-based digital flat panel detectors (FPD) are increasingly being used in these procedures and are replacing traditional X-ray image intensifiers (XRII) due to their high spatial resolution, compact size and distortion-free imaging. Unfortunately, current state of the art FPD systems suffer from the presence of substantial noise in the readout electronics, particularly in the low clinical X-ray exposure region (0.1 – 1 mR/frame) and as such are not quantum noise limited.[1,2]

Although significant reductions in electronic noise are unlikely, the noise may be overcome by adding a gain stage which amplifies the weak image signal before it is read out. Towards this end, certain researchers are developing active pixel readout circuits which incorporate an amplifier at each pixel of the FPD.[3] Such systems, however, are typically difficult to implement in conventional thin film transistor (TFT) manufacturing processes, take up more pixel area and are prone to radiation damage. Alternatively, high gain photoconductors such as PbI_2 or HgI_2 may be used,[4] but large area, defect-free deposition of these materials is difficult and they suffer from limited charge range.

We present a different approach which consists of using an amorphous selenium (a-Se) photoconductor, a well characterized X-ray image receptor, as a very high sensitivity imager. Biased at a sufficiently high electric field, photo-generated charge in the a-Se undergoes avalanche multiplication, thus providing the gain required to overcome electronic noise in low-exposure radiography and fluoroscopy applications. We have previously performed a feasibility investigation of this concept.[5]

Device operation and experimental methods

The detector structure under investigation is shown in panel (a) and consists of a high resolution scintillator (structured CsI phosphor) which converts X-rays into light photons that are in turn absorbed in the a-Se photoconductor and generate electron-hole pairs. The a-Se is 15 mm thick and is biased at an electric field in the range 10 – 120 V/mm using a high voltage power supply. At fields exceeding the avalanche threshold (75 V/mm), photo-generated holes in the a-Se undergo impact ionization and produce additional electron-hole pairs in an avalanche process. Blocking contacts on either end of the a-Se layer limit hole and electron injection from electrodes into the a-Se, thus reducing current leakage through the detector (or dark current). A resistive interface layer (RIL) consisting of a 5 mm thick cellulose acetate polymer prevents sporadic electrical discharges in the a-Se from producing irreversible crystallization of the amorphous photoconductor and precluding operation of the FPD. At the output, a thin film transistor (TFT) array and readout electronics convert the collected photo-generated charge at each pixel into a digital signal which constitutes the final image.

Here, we characterize the performance of the novel a-Se-RIL composite device (excluding the scintillator and TFT layers). The

(Continued on page 103)

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device is subjected to pulses of light which mimic the output of a CsI scintillator exposed to very low intensities of X-ray radiation within the clinically-relevant exposure region (0.1 – 1 mR/frame). By varying the high voltage bias applied to the device in the range 150 – 1800 V (corresponding to electric fields in the 10 – 120 V/mm range in the a-Se layer) and measuring the amount of charge generated in the a-Se using an oscilloscope, we obtain the avalanche gain characteristic of the device. The dark current is also measured using an electrometer. Temporal characteristics of the a-Se-RIL composite device are assessed using the time-of-flight (TOF) method, which consists of exposing the device to short (1 ns) laser pulses from a 337 nm nitrogen laser and measuring the resulting electric current pulse.

Results and discussion

Our measurements indicate that the a-Se-RIL composite device is capable of sustaining very high electric fields while maintaining a dark current below 1 nA/mm^2, which compares favorably with crystalline silicon based photoconductors (panel (b)). The RIL effectively enables stable operation of the device at the high electric fields required for avalanche multiplication. Gains as high as 10^4 are possible (panel (b)) which suggests this device, when coupled to CsI, can provide a solid-state replacement for the XRII.

Avalanche multiplication in a-Se has enabled the development of a high sensitivity broadcasting camera at NHK in Japan with measured avalanche gains as high as 10^3. In this camera, the photosensitive a-Se layer is enclosed in a vacuum tube and scanned by an electron beam.[6] The a-Se-RIL composite device, investigated here, is a solid state alternative which can provide similar or even larger gains than are possible with the vacuum device. This is an important advantage because it enables the device to be scaled up to as large an area as is necessary for radiographic and fluoroscopic imaging applications, while maintaining the small package size of conventional FPDs.

In previous work, we have determined that an avalanche gain of 20 is required to sustain a quantum noise limited detective quantum efficiency (DQE) at fluoroscopic X-ray exposures in the range 0.1 – 10 mR/frame. At radiographic exposures in the range 30 – 3000 mR/frame, a gain of 5 is enough for optimal operation. Thus, the a-Se-RIL composite device provides much higher gains than what is required for overcoming electronic noise, even at the lowest fluoroscopic and radiographic X-ray exposures. This is encouraging and suggests that the fabrication of robust FPDs with avalanche gain and dark currents below 10 pA/mm^2 is feasible. Furthermore, because the avalanche gain is strongly dependent on the applied HV bias, the gain can easily be turned on at low X-ray exposures to maximize sensitivity and turned off at higher exposures to prevent saturation of the detector. This programmable gain feature effectively enables a very wide dynamic range, which is crucial for clinical imaging applications in which the exposure at the detector can vary over more than five orders of magnitude.

It would seem that the presence of the RIL, a resistive layer which provides stable device operation at high electric fields, would significantly degrade the temporal response of the device. However, our TOF measurements show that the detector response is shorter than 100 ns (panel (c)). Thus, imaging at 30 or 60 frames per second using the composite a-Se-RIL device should not present a problem.

These findings are very exciting and extend beyond applications in high sensitivity FPDs: the technology investigated here enables largely scalable and cost-effective solid-state imaging devices for any diagnostic medical application that is concerned with detecting very low amounts of radiation such as positron emission tomography, single photon emission computed tomography or tomosynthesis. There are also numerous other potential applications such as in protein crystallography, astronomy, broadcasting and consumer electronics.

Conclusions

We have developed and characterized a novel solid-state device capable of providing very high avalanche gains and an excellent temporal response. The device which is based on the amorphous photoconductor a-Se, is scalable (i.e. can be manufactured in large areas), can overcome electronic noise even at the lowest clinical X-ray exposures used in diagnostic imaging and has a low level of dark current. Coupled to a high-resolution X-ray scintillator and TFT array, this device should provide a true solid-state alternative to the X-ray image intensifier, which is both robust and cost-effective. This should open the door to dose-efficient flat panel imaging detectors for radiography and fluoroscopy as well as a number of other demanding medical imaging applications.

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See Page 104 for Figures

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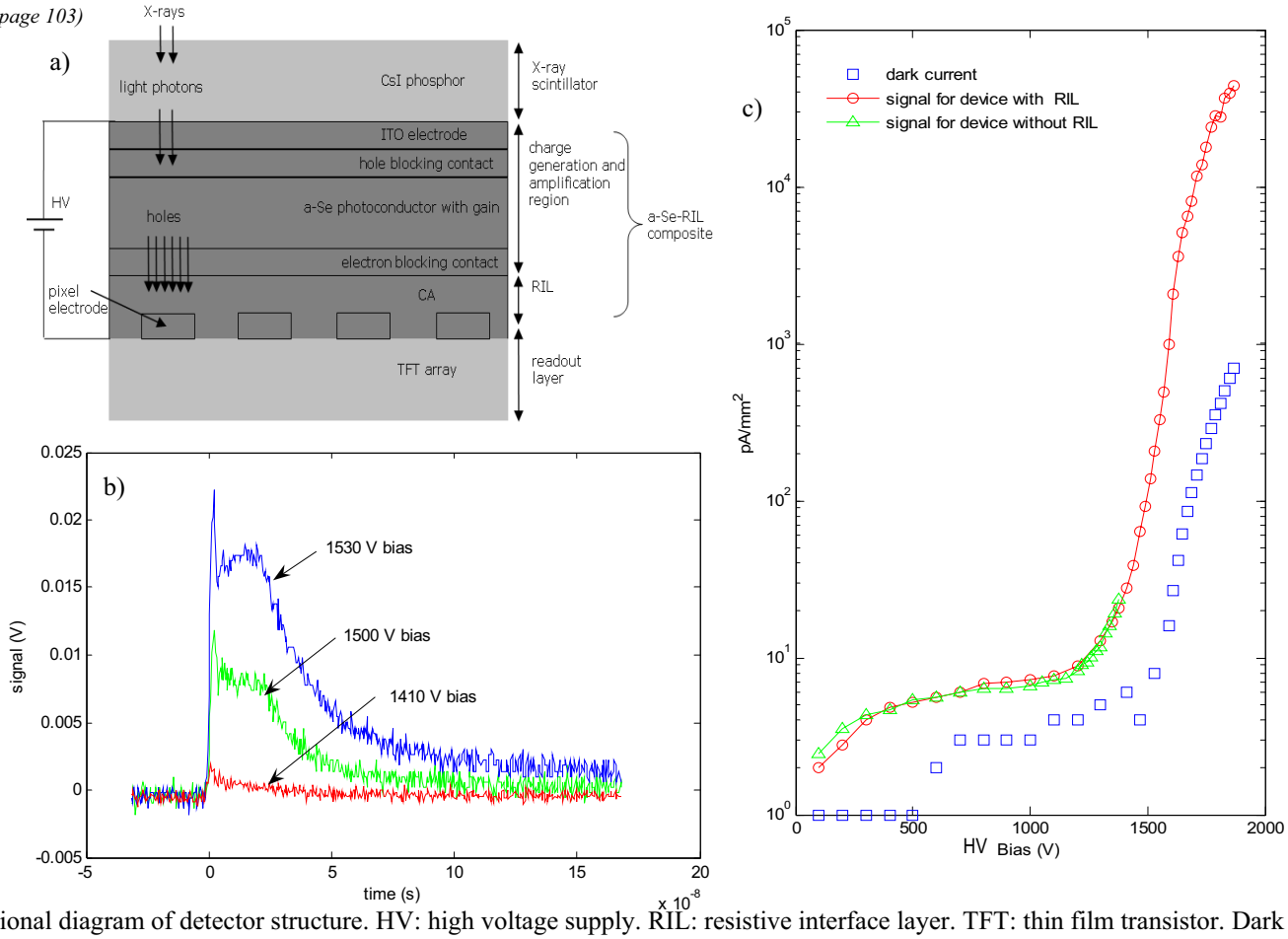

(a) Cross-sectional diagram of detector structure. HV: high voltage supply. RIL: resistive interface layer. TFT: thin film transistor. Dark grey region: a-Se-RIL composite device. Light grey region: additional layers for X-ray conversion and image readout. (b) Magnitude of dark current and signal current as a function of applied HV bias for the device with and without the RIL. (c) Response of a-Se-RIL composite device to a 1 ns laser pulse at 1410, 1500 and 1530 V bias.

3rd Place Presentation

On-line adaptive radiation therapy based on the intra-fractional digital tomosynthesis images

A. Mestrovic[1], A. Nichol[1], B. Clark[2], K. Otto[1], (1) BC Cancer Agency, Medical Physics, Vancouver, BC (2) Ottawa Regional Cancer Centre, Medical Physics, Ottawa, ON*

Introduction:

In on-line ART, the original treatment plan is modified based on inter-fractional deformations of patient anatomy just prior to a treatment fraction. By accounting for the anatomy deformation the original dose distribution can be closely tailored to the current target shape, thus minimizing the dose to the surrounding healthy tissue. One of the current drawbacks for clinical implementation of on-line ART is the substantially extended treatment time. Prolonged treatment times result in decreased patient throughput, as well as increased susceptibility to intra-fractional deformations[1] and patient motion during the treatment. Currently, on-line ART does not account for intra-fractional deformations and patient motion during the treatment since daily imaging is performed only at the beginning of the treatment fraction.

This study is the first investigation into the feasibility of performing on-line ART based on the intra-fractional digital tomosynthesis (DTS) images. The advantage is a reduction of the treatment time and as a consequence decreased susceptibility to patient motion during the treatment and intra-fractional deformations. Also, by continuously imaging the patient during the treatment, patient motion and intra-fractional deformations can be detected and accounted for.

Materials and Methods:

A. Anatomical model

A model simulating a typical prostate case is created in the Eclipse treatment planning system (TPS). Prostate carcinoma is an appropriate example because significant changes in anatomy from day to day are well documented[2]. However, the approach and ideas developed here are completely generalizable and could be applied to other treatment sites. In consultation with a radiation oncologist, a model is created where a prostate, rectum and a bladder are represented by an ellipsoid, cylinder and a sphere, respectively. The model

(Continued on page 105)

(Continued from page 104)
anatomy resides in a square phantom. The dimensions and positions of these structures are chosen to be as realistic as possible and represent a typical prostate patient with a full bladder. The prostate, rectum, bladder and phantom (body) contours are exported from the TPS into MATLAB using DICOM RT. In MATLAB, a 3D virtual patient is created by "filling" each contour with the material of an appropriate electron density. The electron densities relative to water assigned to prostate, rectum, bladder and body are 1.05, 0.95, 1.10 and 1.00, respectively[3] (Fig 1a). Next, the original anatomy is deformed by enlarging the rectum. As a result of enlarging the rectum, the prostate is expanded in the left-right and superior-inferior directions and compressed in the anterior-posterior direction. Also, the shape of the prostate is changed from convex to concave, due to localized pressure from the rectum. Three different "deformed anatomies" are created by systematically deforming the original anatomy by various amounts. The deformations represent small, medium and large clinical deformations (Fig. 1 [b-d]).

B. Original treatment plan

We have focused our attention on IMRT plans obtained by direct aperture optimization (DAO)[4]. DAO is a technique used to optimize directly the leaf positions and aperture weights in IMRT treatment plans. It has been demonstrated that DAO is capable of producing high quality plans with a significant reduction in both the number of beam segments and the number of monitor units compared to traditional fluence-based optimization techniques[4]. This results in shorter treatment times and increased patient throughput. Our DAO system is used to create the "original treatment plan" for the original anatomy. Seven beams are used with gantry angles of 110, 80, 40, 355, 310, 280 and 250 degrees, with six apertures per beam. The number of beams and gantry angles are obtained from our institutional prostate IMRT protocol in clinical use. The dose-volume constraints for the bladder and the rectum are based on the RTOG 0415 prostate IMRT protocol[6].

C. Non-adapted original plan

The effect of using the original treatment plan for the three deformed anatomies is investigated. This is done to assess the degree of plan quality deterioration when no adaptation of the original plan is performed.

D. Image acquisition

Daily imaging is performed using an on-board imaging (OBI) system mounted orthogonally to the treatment beam. X-ray projections are continuously acquired as the gantry rotates between treatment positions. Figure 2 shows the angular range through which the x-ray projections are acquired as the primary treatment beam rotates counterclockwise from the initial position (gantry angle=180 deg) to the first treatment position (gantry angle=110 deg). This process is continued as the treatment beam rotates from the first treatment position to the second treatment position, from the second treatment position to the third treatment position, etc. Therefore, the total angular range through which the x-ray projections are acquired progressively increases as the treatment beam rotates between seven treatment positions.

X-ray projections are generated by forward projecting through the virtual patient from the x-ray source to the x-ray detector[7]. The generated projections are computed to match the x-ray projections that would be acquired with the OBI system as the gantry rotates between treatment positions. The projections are calculated in MATLAB using ray-tracing technique, with angular spacing of 0.50 deg and detector resolution of 0.25 mm by 0.25 mm defined at the isocenter. The source-to-axis distance (SAD) and source-to-detector distance (SSD) are 100 cm and 150 cm, respectively. All values are closely matched to those used by the Varian (Varian Medical Systems, Palo Alto, CA) OBI system.

The x-ray projections calculated by forward projecting through the virtual patient do not account for various factors that can affect the Cone Beam CT (CBCT) imaging performance such as the photon statistics (quantum noise), electronics noise, detector blurring, detector pixel size, etc. To account for image degradation due to these factors, detector blurring and system noise are experimentally measured and added to the calculated x-ray projections prior to image reconstruction[8]. Detector blurring is modeled by a two dimen

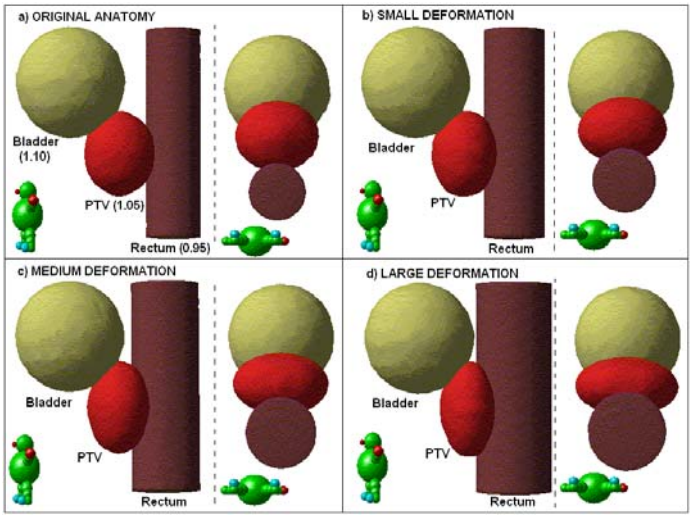

Figure 1: A model simulating prostate case: a) Original anatomy. b-d) Three deformed anatomies. The planning target volume (PTV) is created by adding a 5 mm margin around the prostate

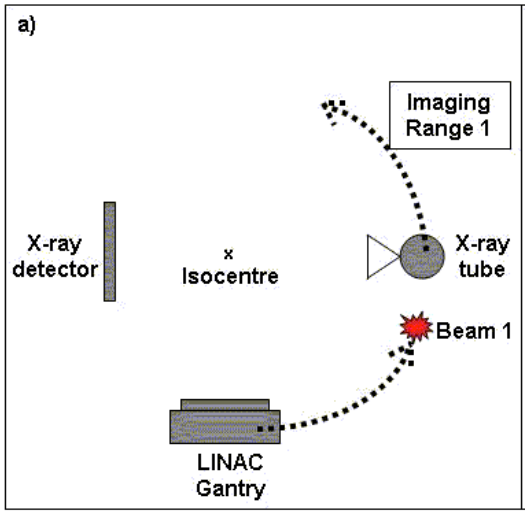

Figure 2: X-ray projections acquired with the OBI system as the MV beam rotates counterclockwise from the initial position to the first treatment position

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sional Gaussian point spread function. The standard deviation is experimentally determined from the line spread function measurement to be 0.2 mm. System noise is sampled from the Gaussian probability density function. The system noise standard deviation (σ_n) is experimentally determined from the noise power spectrum (NPS) analysis (Fig. 3).

E. Image reconstruction

The Feldkamp filtered back-projection algorithm[9] is used to reconstruct a 3D DTS image from the limited angle x-ray projections data. All of the image reconstruction is performed using the projections with the system noise and detector blurring incorporated. Reconstruction is performed on the same axial set of planes (with 3 mm spacing) on which the original anatomy contours are defined in TPS. This way, the original contours can be directly used as a starting point in DTS image segmentation. Since the total angular range through which the x-ray projections are acquired progressively increases as the treatment beam rotates between treatment positions, the reconstructed DTS image quality also improves as the treatment beam rotates between treatment positions, since more and more x-ray projections are available for the DTS image reconstruction.

F. Image segmentation

An edge detection algorithm is used to automatically segment 3D DTS image as the gantry arrives at each treatment position. Edge detection is performed using a Probabilistic Data Association Filter[10] (PDAF).

G. Original plan adaptation and radiation delivery

At each treatment position (beams 1 to 7) radiation is delivered based on the treatment plan re-optimized for the most recent DTS image contours. The plan re-optimization is performed using modified DAO. We have previously shown that through modification of the DAO algorithm the optimization search space can be reduced, and as a result, plan adaptation can be significantly accelerated[11]. In an attempt to reduce the adaptation time even further, our group was the first to propose and investigate a new approach to on-line ART in which the plan adaptation and radiation delivery are integrated together and performed concurrently[11]. The advantage of combining plan adaptation and radiation delivery is that most of the plan re-optimization is performed during the radiation delivery, so the time spent adapting the original plan does not significantly increase the overall treatment time.

Results:

A. Original treatment plan

The dose-volume histograms (DVHs) for the original plan used for the original anatomy are shown in Figure 4. Based on the dose-volume constraints from the RTOG 0415 prostate protocol this treatment plan is clinically acceptable.

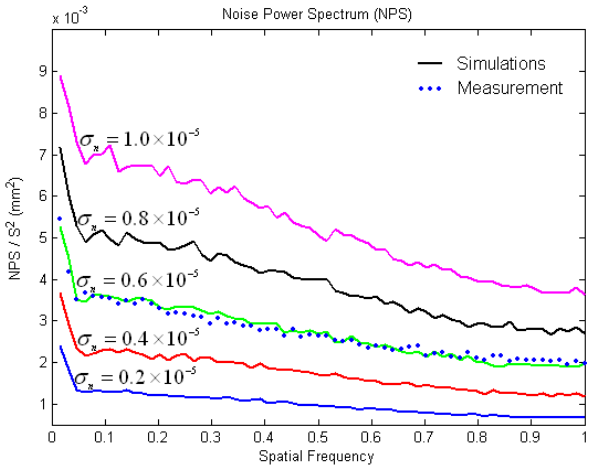

Figure 3: Experimentally measured NPS and simulated NPSs corresponding to different values of σ_n. The most appropriate value of σ_n is determined to be 0.6*10^-5. The spatial frequency on the x-axis has been rescaled so that Nyquist frequency is normalized to 1.

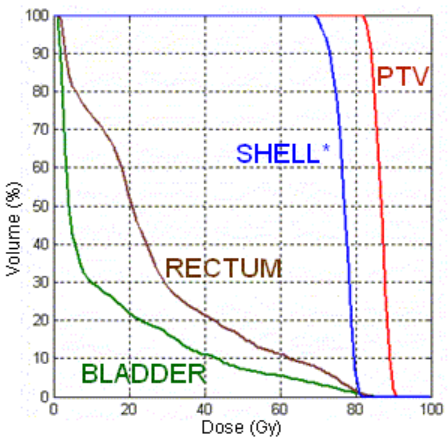

Figure 4: DVHs for the original plan used for the original anatomy.
*Shell (PTV + 5mm margin) eliminates hot spots outside the PTV

B. Non-adapted original plan

Figure 5 shows the DVHs for the non-adapted original plan used for the deformed anatomies. The original treatment plan becomes clinically unacceptable for all three deformations, based on the dose-volume constraints from the RTOG 0415 prostate protocol. As expected, the level of plan quality deterioration closely relates to the extent of the anatomy deformation.

C. Adapted original plan

At each treatment position (beams 1 to 7) radiation is delivered based on the treatment plan re-optimized for the most recent DTS image contours. The quality of the reconstructed DTS image improves as the treatment beam rotates between treatment positions, since more and more x-ray projections are available for the DTS image reconstruction. Figure 6 shows one of the axial slices of the segmented DTS image at each treatment position.

(Continued on page 113)

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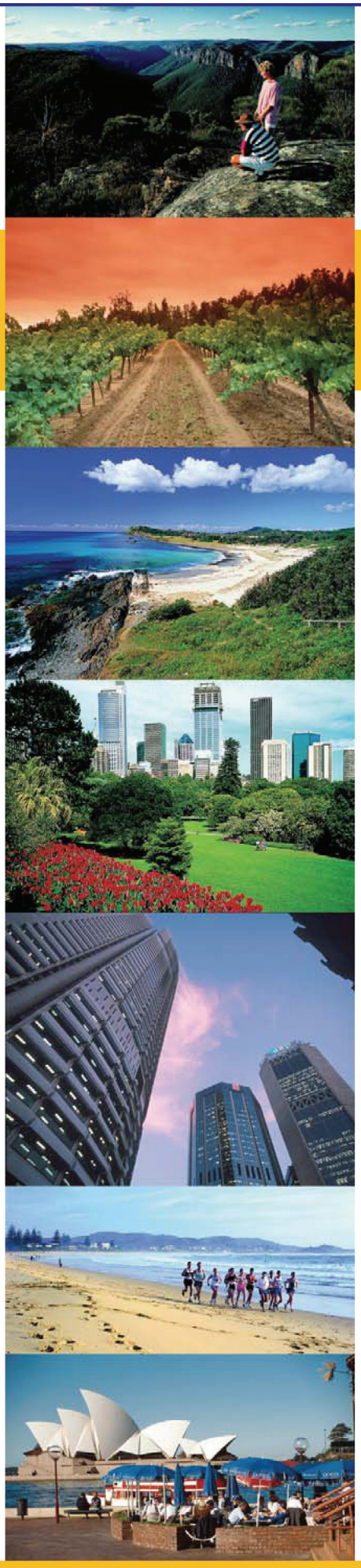

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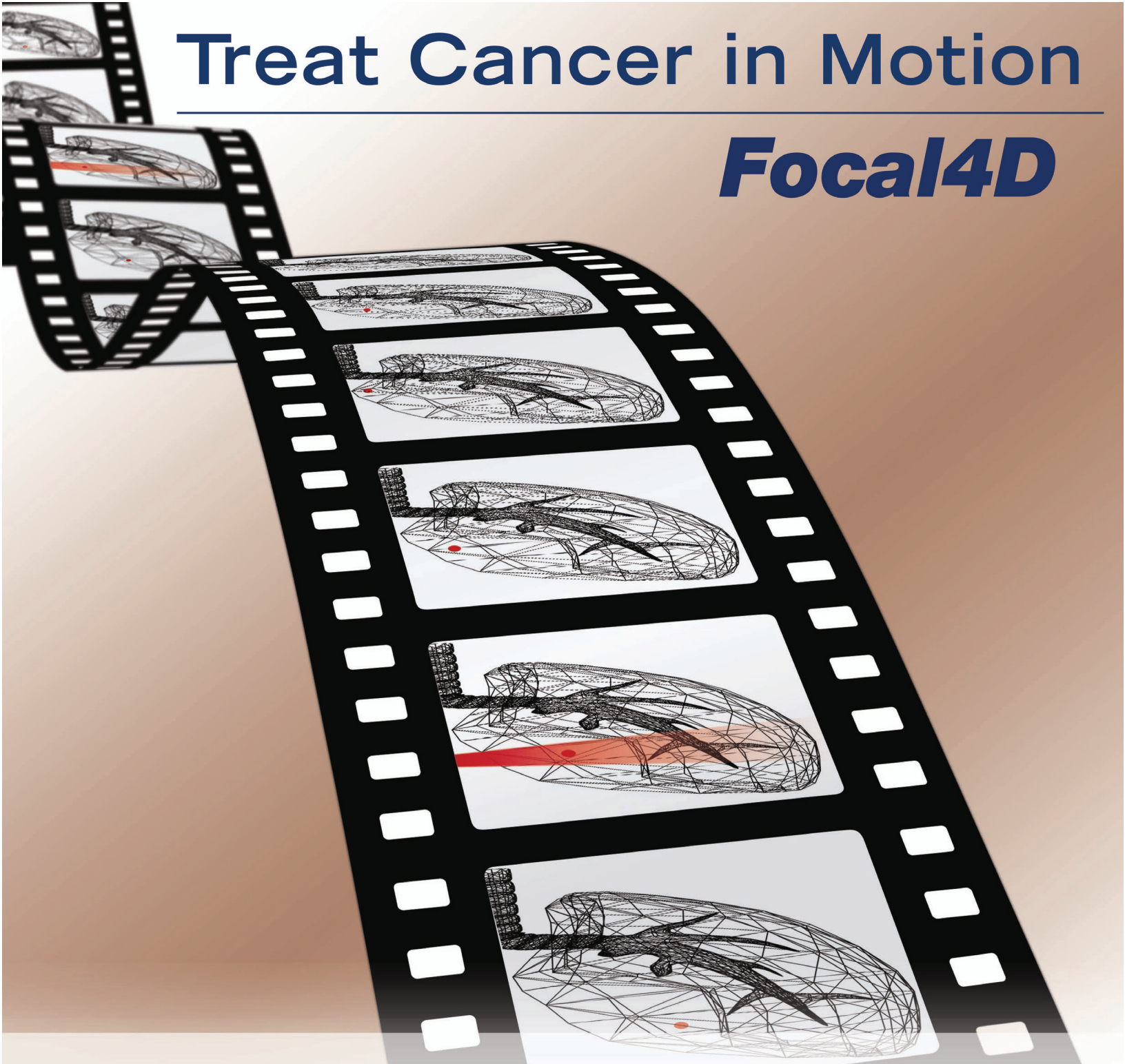

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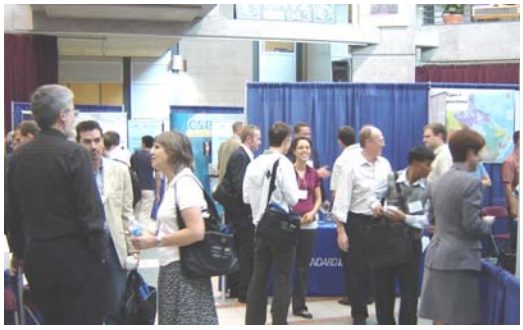
Vignettes of COMP 2008, Quebec City

Good eats, and great views at the Ice Breaker Reception

Dr. Raymond, one of the presenters at the COMP public lecture

Exhibits are open! Time for wheeling and dealing!



… more coffee and snacks
… and more coffee ...

Luc and his 'LAC'kies

The top 10 finalists of the Young Investigators Symposium, along with Jack Cunningham (far left) and J-P Bissonette (far right)

Peter O'Brien receiving thanks for COMP from the new Past Chair, Stephen Pistorius

… more hustle-bustle in the exhibits area

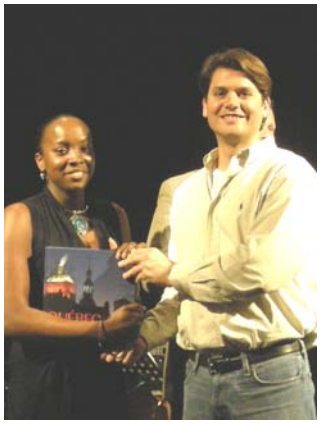
A crowd gathers around an infant Medical Physicist outside the doors of the museum

Vignettes of COMP 2008, Quebec City… continued

COMP exchange physicist, Surendra Chand, from Nepal absorbing the COMP meeting.

… and (a few) of the winners are… (boy were there a lot of winners that night!)

Don McCreath (Standard Imaging) & Sherry Connors



Nadia Octave & Trent Van Arkel (Lap of America)

Vic Peters & Yvies Archambault (Varian)

Sylvia Fedoruk Winners (left to right) L Beaulieu, M. Bazalova, and F. Verhaegen (missing Author S Palefsky) presented by Narinder Sidhu

Cool bass and sax in the jazz ensemble provides the ambiance at the night out

Some serious finger-wagging and wine-sipping

More great eats and venue, and a few sad faces on those who didn't win a prize...

An ending note to an excellent meeting.

(Continued from page 106)

Using our integrated approach to on-line ART, the original treatment plan is successfully adapted to arrive at the clinically acceptable plan for all three anatomy deformations, as shown in figure 7.

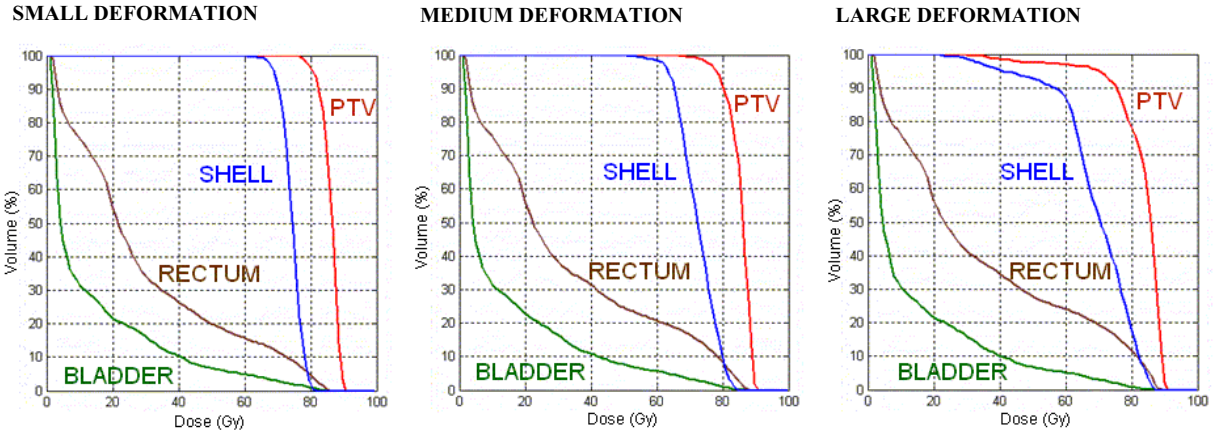


Figure 5: DVHs for the non-adapted original treatment plan used for the small, medium and large deformation.

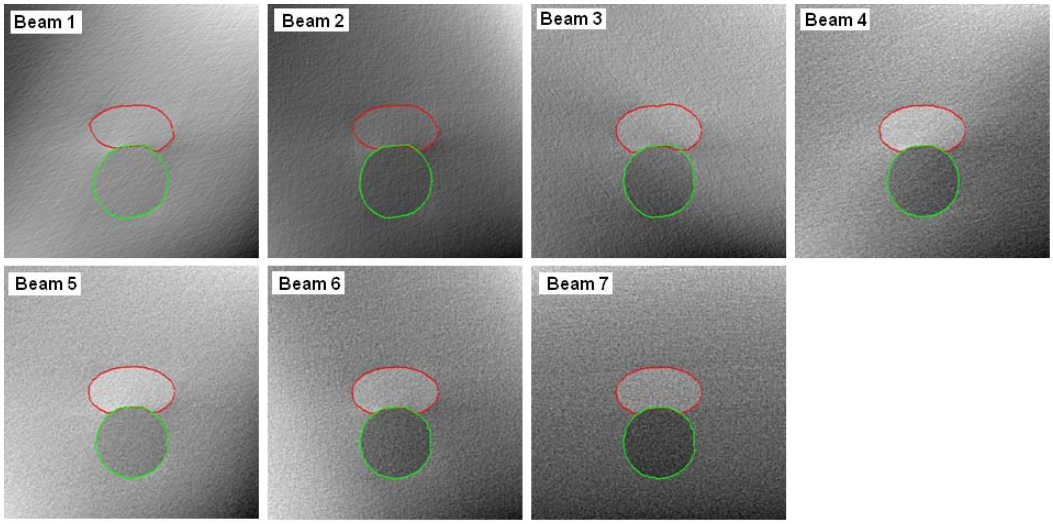


Figure 6: One of the axial slices of the segmented DTS image at each treatment position (beams 1 to 7). The image quality improves from left to right since more x-ray projections are available for the DTS image reconstruction.

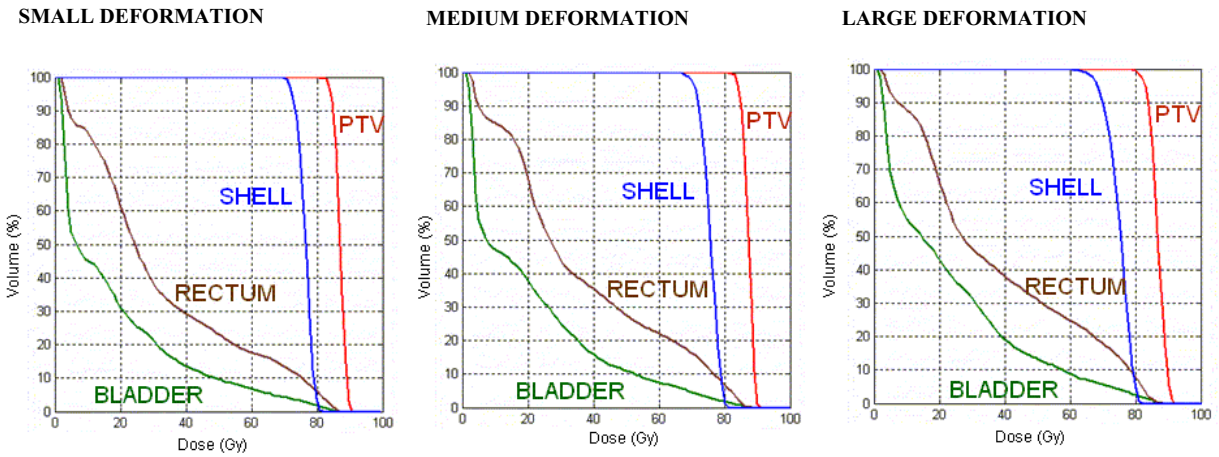


Figure 7: DVHs for the adapted original treatment plan for the small, medium and large deformation.

Conclusion:

We have shown that performing on-line ART based on the intra-fractional DTS images is feasible. The advantages are reduced treatment time and the ability to detect and account for patient motion during the treatment fraction.

References:

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(Continued on page 127)

2008 COMP ASM and CCPM Symposium Delegate Survey

Thank you to the 76 participants who took time to respond to the survey. Further congratulations go to Martin Shim whose name was drawn from the survey participants to win a $50 Chapters gift certificate. Once again delegates came away from our Annual Scientific Meeting with a positive impression of the events. Of particular note, the Gold Medal Awards Ceremony and the final banquet were extremely well received as were the scientific sessions and the CCPM Symposium. In fact, if you go down the list, for 13 of the 15 aspects of the meeting that were evaluated, the response was either "Excellent" or "Very Good".

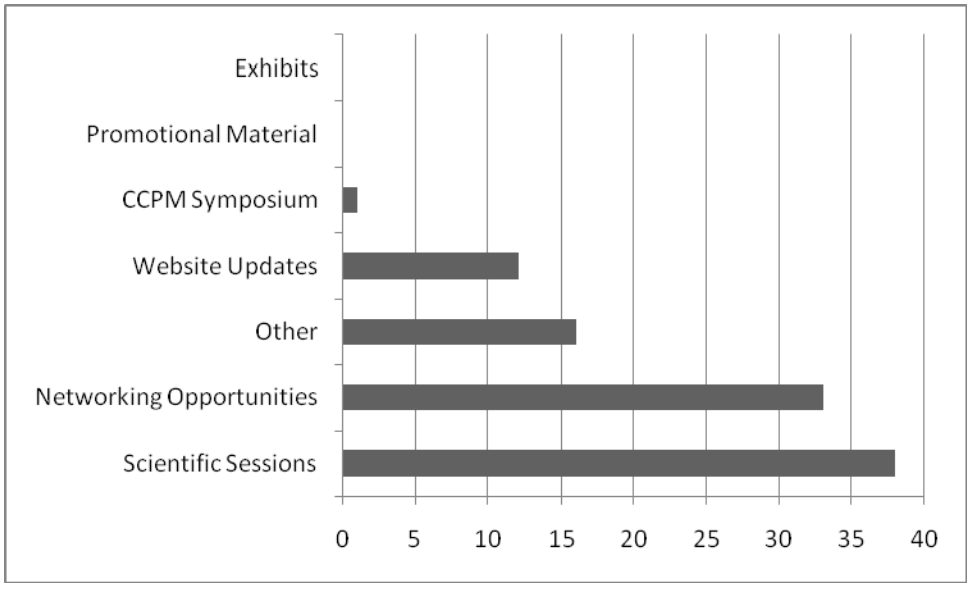
In terms of additional comments provided about the conference program, it was suggested that perhaps the public lecture be re-visited to either attract more of the "public" or abandoned and the time used for workshops or other sessions.

Looking at what influenced the decision to attend this year's Annual Scientific Meeting, the general consensus was to learn and to network, as can be seen from the chart below.

In terms of the direct questions:

- The majority of the registrants stayed at the Hôtel Classique (53%), with 33% staying at the University residence, 8% staying at another hotel, and 7% staying elsewhere.
- To the question: ***"Overall, what did you like best about the Quebec City meeting?"*** the quality of the scientific papers and sessions was mentioned most often. In addition, the networking opportunities and the Gold Medal Award Ceremony were mentioned in glowing terms by a number of respondents as well as the Quebec City location and overall organization of the meeting. There were also a number of positive comments about the bus passes provided to all delegates.
- To the question: ***"Overall, what did you like best least the Quebec City meeting?,"*** a number noted that the exhibit/ coffee break/lunch area was less than adequate. Other respondents noted that the food was of a poor quality and that the hotel and residence were below par and too far removed from downtown Quebec City. There was not adequate time to explore the sites.

	Excellent	Very Good	Good	Fair	Poor	N/A
Online registration process	32%	**42%**	15%	7%	1%	3%
Onsite registration	21%	28%	13%	0%	0%	**38%**
Conference Materials	32%	**51%**	17%	0%	0%	0%
Accommodations	15%	**34%**	**34%**	8%	8%	1%
Cost of Accommodations	21%	**41%**	25%	9%	1%	3%
Coffee Breaks and Lunches	22%	**32%**	29%	13%	4%	0%
Value for the registration fee	17%	**53%**	18%	7%	3%	2%
Ice Breaker Reception	20%	**43%**	13%	1%	3%	20%
Public Lecture	20%	**38%**	25%	1%	3%	13%
CCPM Symposium	13%	**41%**	25%	11%	0%	10%
Scientific Sessions	25%	**53%**	22%	0%	0%	0%
Vendor Exhibits	5%	37%	**40%**	13%	3%	2%
Poster Session	9%	**40%**	35%	12%	3%	1%
Gold Medal Awards Ceremony	**49%**	30%	13%	1%	0%	7%
Final Banquet	**50%**	32%	9%	0%	1%	8%



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2008 Gold Medal Presentation

Introduction Speech by Michael Evans, MSc, FCCPM
Laval University, Quebec City, QC

The Canadian Organization of Medical Physicists (COMP) honoured this year's winner of the Gold Medal Award in a special ceremony at its annual scientific meeting held in Quebec City.

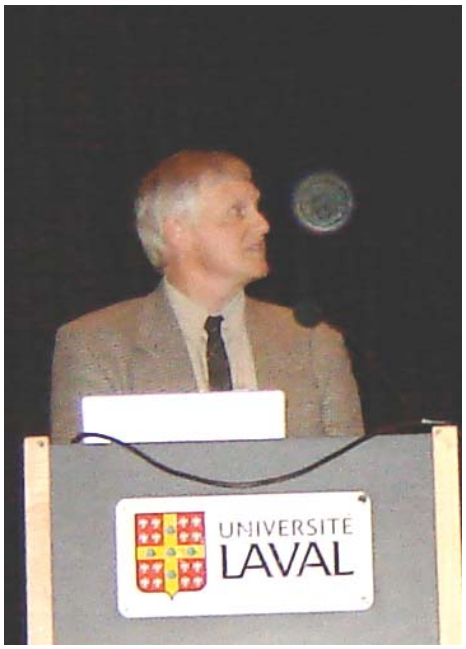
The Gold Medal is the highest award given by the COMP and recognizes an active or retired member who has worked mainly in Canada, has had an outstanding career and has made a significant contribution to the field of medical physics in Canada. A significant contribution is defined as one or more of the following:

- A body of work which has added to the knowledge base of medical physics in such a way as to fundamentally alter the practice of medical physics.
- Leadership positions in medical physics organizations which have led to improvements in the status and public image of medical physicists in Canada
- Significant influence on the professional development of the careers of medical physicists in Canada through educational activities or mentorship

This year, the Gold Medal was bestowed upon Ervin B. Podgorsak, Ph.D., FCCPM, DABMP. Dr. Podgorsak, a native of Slovenia, moved to the United Sates in 1968 and received his M.Sc. and Ph.D. in physics at the University of Wisconsin. In 1973 he moved to Toronto where he continued post-doctoral work and began work as a clinical physicist at the University of Toronto and the Princess Margaret Hospital. Following pioneering work in solid state physics and medical linear accelerator target design he moved to McGill University in Montreal in 1975. His role at McGill progressed through the directorship of the three hospital based medical physics programs (1979), as tenured Professor (1983), and as Director of the Medical Physics Unit graduate program (1991). Dr. Podgorsak continues to serve in all these roles.

Ervin is the author or co-author of some 185 peer reviewed publications, and has just recently published a text book on radiation physics and edited a handbook for teaching of radiation oncology physics for the International Atomic Energy Agency (IAEA). He is still actively involved with teaching and research at McGill. During his career he has also been involved with the development of many innovative cancer treatment techniques including electron and photon total body irradiation, HDR brachytherapy, mono-isocentric breast irradiation, arc therapy, and most notably was a pioneer in the development of dynamic stereotactic radiosurgery. Through his career Ervin has assumed leadership roles in the Canadian College of Physicists in Medicine (CCPM) as Chief Examiner and President, the Canadian Organization of Medical Physics (COMP) and is an advisor to several Canadian granting agencies. In addition, he has been and continues to be active in the American Association of Physicists in Medicine (AAPM) and the IAEA where he is involved as an advisor for technical and teaching committees. In July 2006 Dr. Podgorsak was given the Coolidge award in recognition of lifetime achievement in medical physics by the AAPM at their annual meeting in Orlando Florida.

Dr. Podgorsak's accomplishments as teacher and mentor are evident in the close to 200 M.Sc. and Ph.D. graduates of the McGill Medical Physics Unit who have had the opportunity to experience his lecturing and research skills during the formative years of their careers. His former students can now be found in cancer centers and universities across Canada and throughout the world. He was also responsible for the CAMPEP accreditation of McGill's M.Sc. and Ph.D. programs in medical physics (1993) and the hospital based medical physics residency program (2000). Ervin has always strived to be a role model to others in terms of his medical physics skills while always keeping the needs of the patient paramount, and his dedication to the development of medical physics in Canada makes him a worthy recipient of the 2008 COMP Gold Medal award.



2008 Gold Medal Presentation Speech

Ervin Podgorsak, Ph.D. FCCPM, FAAPM
McGill University Hospital, Quebec, QC

Excerpt from Gold Medal acceptance speech by E.B. Podgorsak at the Université Laval in Quebec City, June 27, 2008

Dr. Pistorius, Chairman of the COMP; Dr. Drost, Chairman of the CCPM; Dr. Rogers, Chairman of the COMP Gold Medal committee; Members of the COMP Gold Medal Committee; Distinguished guests; Ladies and Gentlemen; Mesdames et Messieurs; Family, Colleagues and Friends:

It is a great privilege and honour for me to stand before you here today. I accept the COMP Gold Medal with great pleasure but also with a realization that I have many colleagues across Canada, some of whom are here today, who are just as deserving of this honour as I am.

When Stephen Pistorius and David Rogers notified me of the award I was, of course, delighted but, upon thinking of the list of previous Gold Medal recipients, I felt a sense of unease in addition to pride. All previous honourees have been and still are my role models and to become a member of this distinguished group is a humbling experience. Medical physics is a profession like no other, and I consider myself privileged to have been able to contribute to it to an extent that is deemed worthy of this award. I asked Dave Rogers for some guidance on what to talk about in my acceptance speech. His answer was; "Talk about anything you wish as long as there is some physics content". Dave insisted on physics content because he was worried that I would use up my time with a political rant on whatever I perceive as the current issue of importance to our profession or Canadian society in general, or even worse, that I would test my weird sense of humour on you, the captive audience.

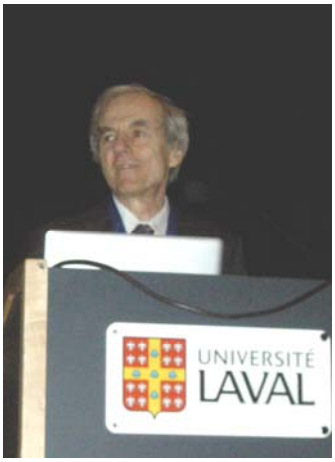
I will first acknowledge people who most influenced my professional life, and then I will briefly address the status of medical physics in Canada and give you my brief perspective on the history of Canadian medical physics. Next, to satisfy Dave's request, I will inject some medical physics content in the form of two medical physics vignettes. I will conclude with a discussion of an issue that, in my opinion, is very important to the future of our profession: the financing of Canadian health care.

Acknowledgments. No man can be successful in professional or personal life without help from family, colleagues, friends, and superiors. Everybody follows the life's winding road with turns that are caused by lucky and unlucky breaks. Many lucky breaks in my private and professional life contributed to my standing here tonight; let me list a few.

I had a widowed mother who instilled in me the understanding that my only way to succeed in life was through hard work and education.

During my studies and professional career I was associated with four universities, each one of them great in its own way. Ljubljana in Slovenia gave me excellent training in basic physics; Wisconsin in Madison gave me graduate physics training and introduced me to medical physics; Toronto trained me in clinical physics; and McGill in Montreal allowed me to devote my professional life to medical physics, a specialty of physics and profession that I truly love.

Special thanks are due to my former teachers and mentors Drs. John R. Cameron and Paul R. Moran from the University of Wisconsin and Drs. Harold E. Johns and John R. Cunningham from the University of Toronto who not only taught me physics and served as role models in my professional life but also introduced me to medical physics, a truly rewarding profession that brings together one's love of physics and compassion for patients. I am probably one of only a few medical physicists who trace their professional roots to two distinguished medical physics dynasties: Cameron's in the U.S. and Johns's in Canada.



I benefited from my interaction with Dr. Montague Cohen who was my physics director during my first four years at McGill in the late 1970s and who started the medical physics graduate programs at McGill in 1979.

I spent my professional life at McGill and dealt with many university and hospital administrative directors, but I had only one clinical director, Dr. Carolyn R. Freeman, the Director of Radiation Oncology at McGill since 1979. She has always been supportive and respectful of my academic and clinical interests, and jointly we created an excellent atmosphere of collaboration between the Radiation Oncology and Medical Physics departments resulting in a respectable academic productivity and translational research the results of which were rapidly introduced into the clinic to benefit the patients.

My clinical colleagues always respected and appreciated the contribution of medical physicists to the treatment of their patients. In particular, my clinical interactions with Dr. Luis Souhami, the Associate Director of the McGill Radiation Oncology Program, were very fruitful, especially in the field of stereotactic radiosurgery, and taught me a lot about clinical work and medicine in general.

I am grateful to my colleagues in the Medical Physics Department who, in addition to expecting me to protect their interests, always supported my departmental and professional goals. I am particularly grateful to Michael Evans who nominated me for this award and with whom I have been associated for the past 25 years. With the passing years Michael has been assuming an ever-increasing role in running the day-to-day activities of the clinic and the Medical Physics Department and serves as an excellent role model to young aspiring clinical physicists.

I had students who with their enthusiasm, inquisitive minds, and youthful naïveté, forced me to be the best teacher I could be, expanded my physics horizon, and showed me that teaching was the most important, rewarding and enjoyable aspect of my professional career.

To my mentors, superiors, colleagues and students I owe great gratitude for giving me the tools and opportunities to develop my interests and move ahead professionally. To my wife Mariana I owe my love and appreciation for 43 years of unequivocal support, care and understanding; for giving me two sons, one of them also a medical physicist; and for keeping the family sane despite the pressures of moving countries, my unfortunate health problems, and my academic work. Mariana, I am

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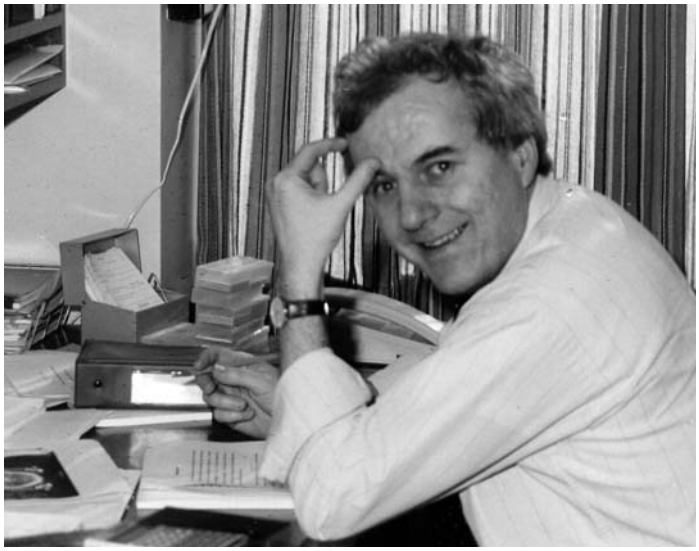
(Continued from page 116)
happy to be able to thank you publicly for the many years of your help and support.

I am happy to be able to share this occasion with my immediate family. In addition to Mariana, my mother and my two sons, Matthew and Gregor, are here today, and so are Matthew's wife Kristine, Gregor's friend Marylise and my grandchildren Alex, Anthony and Kimberly. Now a comment for my grandchildren: "Alex, Anthony and Kimmie, we have two generations of medical physicists in our family, but this is not all that unique, as shown by the Cunninghams in Canada and many such examples in the U.S. We can make it three generations, if you study hard and at least one of you becomes a medical physicist. Wouldn't this be cool?

I spent my professional life at the Montreal General Hospital, a McGill University teaching hospital. After 34 years I am quite attached to the two institutions and I feel privileged to have worked in one of Canada's renowned hospitals and for one of Canada's well-known universities.

Et maintenant, je voudrais dire quelques mots à mes collègues francophones. J'ai étudié la physique en Slovénie et aux Etats-Unis et la physique médicale à Toronto, mais j'ai passé toute ma vie professionnelle à l'Université McGill à Montréal. J'ai vécu au Québec par choix, parce que, malgré quelques problèmes politiques et frictions de temps en temps parmi la majorité québécoise et la minorité anglophone, j'ai trouvé la qualité de vie au Québec très agréable pour mes racines et ma mentalité européennes. J'ai eu des opportunités pour travailler à d'autres endroits en Amérique du Nord, mais, en accord avec ma famille, on a toujours décidé de rester au Québec. Je ne regrette pas d'avoir consacré mes efforts professionnels pour aider la société Québécoise à atteindre les standards très élevés en physique médicale et j'ai toujours trouvé mes collègues francophones respectueux, cordiaux, et gracieux. Je vous remercie de votre appui pendant les années passées et je vous souhaite un succès continu dans le future.

Medical Physics in Canada. Canada has always been strong in medical physics and this tradition continues. The main characteristics of Canadian medical physics are: a high level of professionalism; strong national medical physics organizations; a certification process run by medical physicists for medical physicists; excellent graduate and residency teaching programs spread across Canada; excellent research productivity; and concentration of clinical and academic programs in larger centers.



With the increased sophistication of technology used in medicine, especially in radiotherapy and imaging, the need for medical physics services is growing rapidly. The current number of 500 practicing medical physicists in Canada has essentially doubled from 250 that were active 15 years ago. The two national medical physics organizations in Canada are the Canadian Organization of Medical Physicists (COMP) and the Canadian College of Physicists in Medicine (CCPM). COMP deals with all issues relevant to medical physicists, such as annual meetings; young investigator symposia; liaison with international medical physics and medical organizations; sponsorship of medical physics journals; and collection of dues. The CCPM, on the other hand, representing 260 Members and Fellows, deals only with professional issues, such as: certification of medical physicists; accreditation of medical physics education programs; maintenance of certification; and continuing education.

The "Medical Physics" journal is the official science journal of the American Association of Physicists in Medicine (AAPM) but is also sponsored by the COMP and the CCPM. The mean annual ratio between the number of articles published in "Medical Physics" and originating in Canadian institutions to the number of articles originating in American institutions is about 1 to 5. Based on the population ratio of 1 to 9 between Canada and the U.S., the ratio 1 to 5 in published articles suggests a per capita rate in Canada almost double that in the U.S. and attests to the excellent medical physics research productivity in Canadian institutions.

It is also notable that Canadian medical physicists won 33% of the Farrington Daniels awards (11 of 33) and 25% of the Sylvia Sorkin Greenfield awards (6 of 25). The AAPM bestows the two awards annually for the best articles published in the "Medical Physics" journal, respectively, on the subject of radiation dosimetry and on any other medical physics subject except for dosimetry. The normal Canadian performance in both awards is probably 1 in 4; however, we must recognize our colleague, David Rogers, who with his four Farrington Daniels awards single-handedly improved the Canadian performance in Farrington Daniels awards from 1 in 4 to 1 in 3. And he still probably has one or two Farrington Daniels awards in him.

Another important characteristic of Canadian medical physics is its strong ties with the AAPM. The AAPM has over 5000 members, and some 350 of them work in Canadian institutions and participate on the AAPM Board of Directors and various AAPM councils, committees as well as task groups. The AAPM encourages Canadians to join but recognizes that the COMP must be the priority for Canadian members and charges Canadian members who also belong to the COMP a significantly discounted membership fee.

Among its other professional activities, the CCPM sponsors, as one of four sponsoring organizations, the Commission on Accreditation of Medical Physics Education Programs (CAMPEP). The other three sponsors of CAMPEP are the AAPM, the American College of Medical Physics (ACMP), and the American College of Radiology (ACR).

The CAMPEP accredits four types of medical physics education programs: graduate M.Sc. and Ph.D. programs; residencies in radiotherapy physics; residencies in imaging; and continuing education programs. Similar to Canadian medical physics research, Canadian medical physics education programs also do quite well. Of the 17 graduate programs currently accredited by the CAMPEP, five (30%) are in Canada; of the 20 accredited residency programs in radiotherapy physics, six (30%) are in

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Canada; and of the two accredited imaging physics programs, one is in Canada.

Historical perspective. **Medical Physics has a long and illustrious history in Canada** and many physics departments across the country had already contributed during the 1930s and 1940s to efforts in making the use of ionizing radiation in medicine safe and efficient. There were many pockets of significant early contributions to medical physics spread across Canada; however, none of them were as important, far reaching, and visionary as the program developed by Harold E. Johns. Trained as physicist, Johns's first job was with the University of Saskatchewan and the Saskatchewan Cancer Commission in Saskatoon. While in Saskatoon in the late 1940s and early 1950s, he built the first cobalt-60 teletherapy machine and developed a first class medical physics graduate program. This program trained many graduate students who upon graduation made significant contributions to medical physics in their own right and now form the links in Johns's medical physics dynasty.

In the mid 1950s Johns moved to Toronto accompanied by some of his former students. Together they built the Princess Margaret Hospital (PMH) into one of the pre-eminent, world- renowned centers for medical physics. When he retired in 1980, the PMH and the imprint of Harold Johns largely identified and defined Canadian medical physics.

The year 1980 was a watershed year in Canadian medical physics. Not only did Johns retire; several other important events took place during that year that shifted the focus of the Canadian medical physics from the PMH and spread it onto several other centers across Canada: the CCPM was formed; several new clinical centers were established and many older centers were expanded or rejuvenated; several new graduate education programs in medical physics were inaugurated; and the x-ray section of the National Research Council (NRC) in Ottawa was reorganized and dosimetry work expanded.

After 1980 medical physics research spread rapidly to major provincial centers across Canada, and in radiotherapy physics the PMH was no longer the sole contributor to medical physics research in Canada. Imaging physics also underwent a major expansion after 1980, most notably with the Robarts Research Institute in London and the Reichman

Research Institute in Toronto, both staffed with many eminent medical physicists who proved that radiotherapy physics was not the only exciting and important branch of medical physics.

In the latter part of 1980s many senior medical physicists actually believed that imaging physics was a place to be because radiotherapy physics was a completed discipline with exhausted research opportunities. The early 1990s proved them wrong with the explosion in radiotherapy physics research engendered by rapid advances in treatment planning, in technology of dose delivery, and in imaging for radiotherapy. The advent of the CT-simulator, intensity modulated radiotherapy, and image guided radiotherapy has increased significantly the complexity of dose delivery, highlighting the importance of medical physics in imaging and treatment of cancer. In recent years the new technology has caused convergence of imaging and radiotherapy physics and introduced the PET functional imaging to radiotherapy. It also opened new horizons with advances in molecular imaging based on non-invasive methods for cellular functional imaging using biomarkers.

Vignettes from medical physics. To fulfill my charge of physics content I will now briefly present two vignettes from medical physics. In the early 1970s I worked with Harold Johns at the University of Toronto on the **target and flattening filter problem in linacs**. The PMH has just purchased a Varian linac (Clinac-35) which, in addition to 25 MV x rays, was also delivering clinical electron beams in the energy range from 6 MeV to 32 MeV. Linac has clear advantages over the betatron, such as significantly higher dose rate, much larger field size, and full isocentric mounting. At the time of the linac purchase and installation at the PMH an assumption prevailed that the 25 MV linac beam would have the same penetrating quality in water as did the 25 MV Allis-Chalmers betatron, at that time already in operation at the PMH for a number of years.

It turned out, however, that the 25 MV beam produced by the newly designed linac was significantly less penetrating than the 25 MV betatron beam. Actually, the percentage depth dose distribution of the 25 MV linac beam was identical to that produced by the betatron when operated at 16 MV. Both machines were producing bremsstrahlung x rays with 25 MeV electrons striking a target; however, the two machines had significant differences in the two mundane components forming the clinical x-ray beam: the x-ray target and the flattening filter. The linac had a tungsten thick target (ostensibly to maximize bremsstrahlung production) and a tungsten flattening filter (to conserve space in the linac head), while the betatron employed a thin target and an aluminum flattening filter.

In the current era of dosimetric Monte Carlo calculations, largely through the world class efforts of Dave Rogers and his group at the NRC in Ottawa, students of today would consider the target/ flattening filter quandary relatively simple; they would turn on their computers, carry out some virtual physics experiments, and use Dave's BEAMnrc program or some other similar Monte Carlo program to analyse the problem. In the early 1970s we did not have such a clear choice and experimental approach was de rigeur.

Harold Johns, Alan Rawlinson, Mladen Glavinovic and I carried out ex-

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periments using the research port of the Clinac-35 linac at various energies and with various thick target/flattening filter combinations. In contrast to the high atomic number *Z* target/high *Z* flattening filter of the Clinac-35 linac, we established that a 25 MV linac beam produced with a low atomic number thick target and flattened with a low-*Z* flattening filter exhibits the same penetrating power as did the 25 MV Allis-Chalmers betatron. Furthermore, we showed experimentally that at energies below 15 MV the best thick target/flattening filter combination consists of high-*Z* target and low-*Z* flattening filter, while at energies of 15 MV and above the best thick target/flattening filter combination consists of a low-*Z* target and low-*Z* flattening filter.

In the late 1980s, Rogers and his graduate student Bruce Faddegon worked on this very problem experimentally as well as computationally and essentially confirmed our experimental results. More recently, two graduate students at McGill, Arman Sarfehnia and Keyvan Jabbari, my colleague Jan Seuntjens, and I have studied the feasibility of using for imaging purposes the "orthogonal bremsstrahlung" produced by 10 MeV electrons striking a carbon target. The effective energy of the orthogonal x-ray beam is of the order of 150 keV, compared to the 10 MV energy of the forward x-ray beam.

Dynamic stereotactic radiosurgery. The second physics vignette deals with dynamic stereotactic radiosurgery, a linac based irradiation technique that we developed at McGill in the mid 1980s. Leksell introduced radiosurgery in the early 1950s using orthovoltage x rays. Soon thereafter, he was using protons from a cyclotron and by 1968 developed a dedicated radiosurgery unit, the Gamma Knife, incorporating 179 cobalt-60 sources. In 1974 Larsson speculated that isocentric linacs could be modified for use in radiosurgey and 10 years later first reports on linac-based radiosurgery appeared in the literature. These techniques used the so-called multiple, non-coplanar, converging arcs technique and were developed at various clinics around the world, most notably in Buenos Aires, Vicenza, and Heidelberg. In 1986 Harvard and McGill were the first institutions using linac-based radiosurgery in North America; Harvard used the multiple converging arcs technique developed elsewhere before and we developed our own technique, dynamic stereotactic radiosurgery, in which the linac gantry and the treatment couch rotate simultaneously during the treatment. This dynamic approach simplifies the dose delivery and optimizes the dose fall off outside the target volume. During more than 20 years of clinical radiosurgery at McGill, 10 M.Sc. theses and 3 Ph.D. theses have been produced on the subject of radiosurgery, and over 80 papers have been published on the technique, first technical and physics oriented and more recently clinical.

The development of linac-based stereotactic radiosurgery is a perfect example of translational physics research along the lines of the translational research that Harold Johns started with his colleagues in Saskatoon in 1950s and continued in Toronto during the 1960s and 1970s. This type of work is not only useful for training of graduate students but also benefits patients through a rapid translation of technical innovations into the clinic.

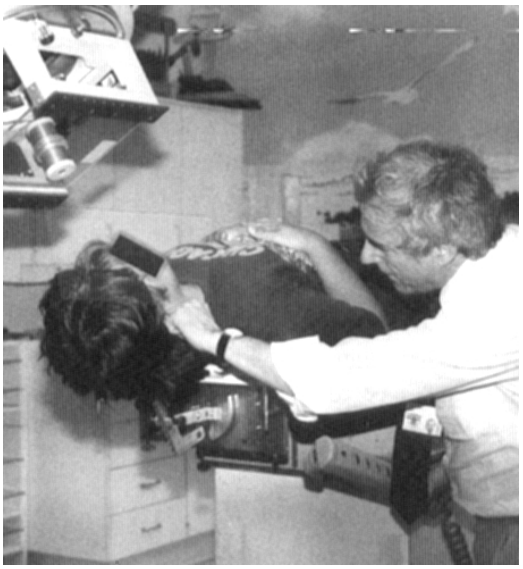
Canadian health care delivery and financing. The last subject of my presentation deals with Canadian health care delivery and financing. These two issues are of interest to the Canadian public in general, but are also of great importance to Canadian medical physicists, since health care financing has a significant impact on all four areas of our activities: clinical service, research, teaching, and administration.

The most important characteristics of a health care system are its QUALITY, ACCESS, and COST. The Canadian health care system is of high quality; however, access to it is definitely problematic, and, arguably, its cost is high. The obvious solution to access problems is increased public funding.

Universal and timely access to health care in Canada is a chronic problem, resulting in waiting lists not only for elective surgical procedures but often also for essential diagnostic procedures such as CT and MRI examinations and for emergency treatment such as cancer radiotherapy. While problems with access to Canadian health care are real and serious, the causes of these problems are shrouded in many myths and misconceptions, especially in relation to the merits of public administration and in the perception of high cost and inefficiency.

The public administration of the Canadian health care service is one of the most cherished defining characteristics of Canada, yet, many special interest groups are touting privatization as the only viable solution to the current health care access problems. Privately run health care can attain high quality standards and provide excellent access to insured patients as well as to those who are willing to pay for services. However, it also results in a two-tiered, socially unjust, medical system in which access to health care depends on patients' ability to pay for services rather than on the need for them.

A perfect example of this privatized and inequitable approach to health care delivery is the U.S. with extremely high standards of medicine on the one hand and 45 million people (15% of population) with no health insurance on the other. The vast majority of Canadians would not want to emulate the inequitable U.S. health care system; however, health care privatization is slowly creeping into Canada. This is happening despite the principle of public administration that is enshrined



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in the Canada Health Act but unfortunately poorly enforced by the federal government.

The Canadian public is constantly bombarded with claims alluding to excessive cost and poor efficiency of the Canadian health care system, yet, it is actually easy to show that Canadian governments, despite their protestation to the contrary, do not spend enough for health care and this shortfall is the main reason for the current serious problems with access to health care for all Canadians.

We often hear that health care expenditures are out of control, having increased more than 10-fold from 1975 to 2005. Yet, once one accounts for the consumer price index increase by a factor of 3.7 and population increase by a factor of 1.4 for the same period, one finds that health care cost effectively increased only by a factor of 2 in 30 years. Considering that in 1975 CT-scanners had just appeared, there were no MRI machines yet, computerization and internet were in a distant future, and many of today's standard diagnostic and therapeutic procedures were still to be discovered or developed, doubling of health care cost in 30 years is certainly not excessive, especially if we compare it to the doubling in the cost of oil during the past year.

The Organization for Economic Cooperation and Development, a closed club of 30 countries, most of them developed, provides useful statistics on the development of individual member states as well as averages for the whole group. Canada is an OECD country and its performance in terms of health care indicators ranges from slightly above average in life expectancy and infant mortality to scandalously below average in access to physicians and such high technology diagnostic equipment as MRI and CT scanners.

To solve the health care access problem in Canada, no elaborate and costly studies, committees or commissions are required. What we need are reasonable and achievable standards and goals for the Canadian health care system and adequate government support to meet the standards and achieve the goals. **For non-monetary health indicators, matching the OECD average should be the minimum standard and exceeding the OECD average should be the goal**.

Unfortunately, Canadian politicians zero in on the cost rather than performance of our health care system. Canada spends 10 per cent of its gross national product (GNP) on health care compared with a nine per cent average for the OECD countries. However, several OECD countries, at 11 per cent, rank above Canada, and the U.S. is in a league of its own at 16 per cent. As a society, Canada decided to give better than OECD average remuneration to its health care workers and this invariably will result in a higher than average GNP cost percentage. However, rationing access to health services to compensate for the higher remuneration of health care workers is shortsighted and not in the best interest of Canadians. Yet, this is exactly what Canadian politicians are doing by keeping the GNP percentage spent on health care close to the OECD average thereby throwing all the important indicators that control access to health care services shamefully below the OECD average. This misguided policy then results in waiting lists, delayed or denied diagnostic and therapeutic procedures, frustration with the health care system, and a stampede to undesirable privatization. There is nothing magic about the current 10 per cent of GNP level; Canada can afford to spend 11 or even 12 per cent of the GNP to bring the access to health care problem under control.

A closer look at the current situation reveals that to attain the OECD average Canada would need to double the number of its MRI machines from 162 to 324 and increase its number of CT scanners by 324 from the current number of 356 at a one-time cost of 1 billion dollars. The 500 new imaging machines would require 1200 new technologists, staff that is currently not available in Canada, and the operating expenses for maintenance and staff would be about $200 million annually.

The situation is just as bleak when one considers at the number of physicians practicing in Canada. To reach the OECD average of 3 physicians per 1000 population from the current level of 2.1, Canada would need to add 30,000 new physicians to its current 70,000 – an extremely difficult proposition considering that the 17 Canadian medical schools produce only about 2500 new physicians per year and this number barely compensates for retirement and emigration of physicians.

Allowing Canada to languish significantly below OECD averages in access to health care is a disservice to all Canadians. It is obvious that governments must stop obsessing about cost and switch their priority to providing sufficient funding to ensure high quality health services without waiting lists. The federal government, through its Canada Health Act (CHA), has the means and obligation not only to set simple and clear standards and goals but also to produce most of the required cash.

When the federal government introduced the public health care system in the late 1960s, its cost sharing formula with the provinces was 50-50; however, with passing decades the federal share dwindled to the current level of 25%. In an era of federal budget surpluses, the expectation that the federal government improve this obvious "fiscal imbalance" in health care financing toward the provinces seems reasonable, realistic, and urgent.

Rather than insisting on 10 per cent or less of the GNP for health care cost, the Canadian federal and provincial governments should provide whatever it takes to get all non-monetary health care indicators above the OECD average. Canadian health care access problems can be solved by a budget increase of 15 to 20 per cent. Canada can afford this, Canadians deserve this, and the governments should finally recognize this with extraordinary funding initiatives.

Conclusions. Ladies and gentlemen, as far as Canadian Medical Physics is concerned I can easily state: Life is good. The current state of Canadian Medical Physics is excellent, its history illustrious, and its future assured, judging from the caliber of today's presentations in the J.R. Cunningham's Young Investigator Symposium.

I will conclude with a Slovenian proverb, very relevant to our work: "*A healthy man has a thousand wishes, a sick man has only one.*" Most of the work of medical physicists is indirectly related to people who have only one wish. We must not forget that despite our scientific and technical training, our strongest guiding principle must be compassion for patients and discipline toward our work. I am proud to be a medical physicist, I am proud to be a COMP member, and I thank you for honouring me today.

Canadian and US Professional Certification in Therapeutic Radiologic Physics – A candidate's perspective

Submitted by: Rao F.H. Khan, Ph.D
Tom Baker Cancer Centre, Calgary, AB Canada

Abstract
In specialized disciplines, with growing professionalism, the importance of certification is becoming more and more obvious. In this article a side-by-side comparison of the two major examinations in North America for the certification of hospital medical physicists in therapeutic radiological physics specialty is presented. These are membership in the Canadian College of Physicists in Medicine, (MCCPM) for Canada and the diplomat of the American Board of Radiology, (ABR) in the USA. An assessment in terms of eligibility, testing processes, financial burden, duration, and professional premise is provided in the following.

Introduction
Medical physicists are the part and parcel of a successful radiation therapy program in any cancer centre around the world. The importance of a certified medical physicist, therefore, can not be overstated. In North America, the certification bodies such as the Canadian College of Physicists in Medicine (CCPM), and the American Board of Radiology (ABR) conduct certification examinations in various subspecialties of physics namely therapy, diagnosis, nuclear medicine etc. The certification examination is held only once in a calendar year.

There are two main steps involved in the certification process: the eligibility for the examination, and the evaluation process. In next two sections eligibility criteria, written and oral components of the evaluation process are described. Personal reflections on various aspects of evaluation by the aforementioned bodies are provided in the discussion section. Through out this communication the discussion was confined to the therapeutic radiologic physics subspecialty.

Eligibility
CCPM: To be eligible for membership in CCPM, the applicants must hold a graduate degree in Medical Physics, Physics, Science with Physics as a major, or another field deemed acceptable by the Board of the College. In addition to this, two years of patient-related experience in physics as applied to medicine is required.

ABR: The eligible candidates for the ABR certification, must document at least 3 years of full-time equivalent experience post-graduate degree in active association with an approved department, division, or practice in the area(s) in which certification is sought. A limited credit toward the 3 years may be given for a clinical component of the graduate program. At least two years of that clinical experience must have been under the supervision of an ABR Radiologic Physics Diplomat. In addition, if the degree is not from a CAMPEP-approved graduate or residency program, the ABR requires documentation of formal coursework in a minimum, 2 courses: one in biology or radiation biology, and the other in anatomy and physiology.

Evaluation Process
Once the eligibility of a candidate is determined, the evaluation process itself consists of two steps *i.e.* written and *viva voce* examinations. Only after a successful completion of the written component the candidate qualifies to appear for an oral examination.
Written examinations
CCPM: In the Canadian system 50% of the marks for the written examination are based on knowledge of the answers to questions available to the candidates in advance, in the form of an examination booklet. These comprise Section III and Section IV of the written examination, out of which five questions in each section are chosen at random. Section I consists of short freeform answer questions covering general medical physics, radiation protection, clinical anatomy and biological science relevant to clinical medical physics practice. Section II consists of short answer questions (with limited or no choice) to test applicant's competence in radiation protection. Four sections complete the written part of MCCPM.

The written examination is supervised by a local invigilator at the home institution of the candidate, if possible. A pass grade is awarded to the candidates achieving an

(Continued on page 122)

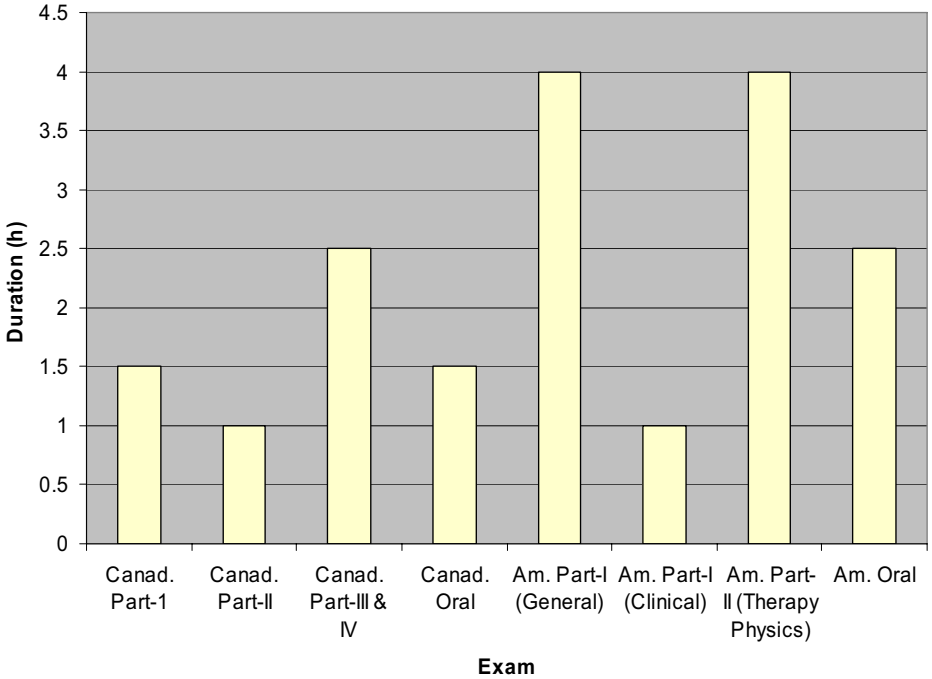

Fig. 1 Duration of various components of examination, the total duration for the MCCPM written examination is 5 h vs. 9 h for the ABR.

Year	% passed	
	Written	Oral
2004	70	75
2005	80	80
2006	78	86
2007	76	88

Table 1: Annual written and oral examination results for the CCPM membership. The data are not specific to radiation oncology specialty, and oral statistics include repeat and deferred candidates (Sixel 2004, Sixel 2005, Sixel, 2006, Evans, 2007).

(Continued from page 121)
overall 65% and at least 50% in each section.

ABR: The ABR written examination consists of three separate examinations: Part I: General, Part I: Clinical and Part II: Therapeutic radiological Physics.

Part I General, covers basic radiologic physics including, atomic and nuclear physics basic statistics, radioactivity, ultrasound, nuclear magnetic resonance, radiation interaction and dosimetry, instrumentation and measurement techniques, basic radiobiology, and radiation protection.

Part I Clinical, includes human anatomy and physiology, biochemistry, medical uses of radiation sources, and radiochemistry.

Part II Therapeutic Radiologic Physics, comprises measurements of radiation quantity and quality, physical principles of radiation therapy, treatment planning and setup, clinical radiation therapy, treatment planning for external beam therapy, brachytherapy, and stereotatic radiosurgery, treatment simulation, radiation oncologic imaging, radiobiological principles of therapy, dose calculations, quality assurance, calibration, radiation protection and safety.

Both Part I and Part II examinations are Multiple Choice Questions (MCQs). Except for Part I Clinical (which comprises 60 questions), the rest of the examinations (each having 80 questions) have two types of MCQs. Type I are easy to calculate while Type II require more thorough manipulations and consume more time. All written examinations are computer-based and organized by the ABR. Since 2007, the written examinations are simultaneously conducted at several Pearson-VUE™ (Pearson Education Inc., USA) locations throughout North America.

Duration of written and oral examinations is shown in Fig 1, whereas the annual success rate is provided in Tables 1 and 2.

Oral examination:
CCPM: The candidate is tested in three separate sessions, each conducted by two examiners. The subject matter covers equipment and instrumentation, clinical application, and specialty knowledge and techniques. The candidate must have answered 2/3 of all questions to be successful.

ABR: The ABR oral examination includes five categories of radiation protection and patient safety, patient-related measurements, image acquisition, processing and display, calibration, quality control and quality assurance, and equipment. The examination is conducted by five different examiners on one to one basis. Each of the five examiners asks questions from all five categories in his allotted 25 minutes. During the examination different questions with diagrams and pictures appear on a computer screen in front of the candidate.

If a candidate fails just one out of five categories he is considered to have "conditioned" the examination. The retake examination for only the failed category is conducted by two examiners. Failing or being unable to appear for three successive chances can result in repeating the entire oral examination.

Discussion
The major difference between the two examinations is in terms of examination style. The MCCPM examination emphasizes the physical basis of radiation therapy in a descriptive manner, whereas the ABR has more applied aspects and analytical look due to its MCQ type questions. For an MCQ with five choices, there is a probability of getting a hit is one in five, while in descriptive answers even lack of focus on the question can still provide some minimum score. Therefore, the element of randomness, even though more obvious in multiple choice type questions, is still present to a varying degree in a descriptive examination.

The candidates can use nonprogrammable calculator in the MCCPM whereas in ABR a Windows™ based calculator (Microsoft Corp., USA) is the only option which is not very user friendly.

In terms of the contents, the MCCPM examination lays emphasis on radiobiology. Instead human anatomy and physiology, and medical terminology are highlighted in ABR oral in addition to a separate written examination as Part 1 Clinical. The question booklet for Section III and IV by the CCPM provides a well defined focus for the candidates, whereas the study guide by the ABR gives a vague outlines of what to expect in examination.

The data presented in Table 1 and 2 for annual success rate is difficult to compare. The candidate success rate should not be taken at their face value, since the CCPM data contain candidates from other subspecialties and repeat or deferred candidates. Moreover, the candidates appearing in the ABR examination constitute a

(Continued on page 123)

Year	% Passed			
	Part-1 General	Part-1 Clinical	Part-2 Therapy Physics	Oral
2003	82	85	75	48
2004	79	84	76	51
2005	77	80	73	59
2006	77	82	69	53
2007	75	79	70	47

Table 2: The percentage of candidates passing the ABR Radiologic Physics examination during the last five year. The oral exam results (last column) are for the first time takers only (The ABR 2008).

(Continued from page 122)
larger sample size compared to CCPM sample.

The scoring scheme for MCQ based examination is not instinctive; it is based on psychometric techniques. Any questions with unusual statistics are reviewed by subject experts to verify the clarity and ambiguity. In contrast, the scoring in CCPM is intuitive and traditional. The element of evenhandedness in the CCPM oral examination is more apparent, compared to the ABR: firstly due to the CCPM setup of having two examiners at any time and secondly due to the possibility of the chief examiner listening to the conversation without any knowledge of examiners and the candidate. The ABR oral examination is held in a hotel, with moves in between several rooms having one examiner each, the door remains open during the examination and the chief examiner can visit each room, however, without remaining obscure to both the examiner and the candidate.

In terms of financial burden on candidates, not including travel, the CCPM charges only CAD450 in examination fees, whereas the ABR examination costs $1700 (in 2007/2008). Without failing any step, it takes up to 20 month to complete certification requirements with the ABR compared to only 5 months for the MCCPM. From a candidate's point of view, staying focus on the Canadian examination is easier than the American.

From June 2007 onward, for the ABR Radiologic Physics certificates, signifies that the diplomat has met the NRC requirements for training and experience in those areas at the time of certification (NRC 10 CFR §35.51). It means that the successful candidate qualifies for NRC recognized status as eligible to be an RSO. On the contrary, for the Canadian certification it is not obvious that the candidate qualifies as a CNSC radiation safety officer.

In the ABR examinations one has only three consecutive opportunities to appear for and pass orals, failure to appear for a scheduled examination will be regarded as one of the 3 opportunities. In case of MCCPM, the number of chances that a candidate can have is not clear.

From 2012, in order to take the ABR Part I examination in Radiologic Physics, candidates must be enrolled in or should have graduated from a CAMPEP accredited education program (e.g., MS, PhD, or residency). Beginning in 2014, in order to take the same examination, the candidates must be enrolled in or have completed a CAMPEP accredited residency program (Frey 2007).

Conclusions

With growing professionalism, the importance of certification is becoming more and more obvious. The radiologic physics certification offered by the ABR and CCPM covers different aspects of the radiation oncology physics, with their obvious edge over the other in certain area. Due to blurring of the boundaries between radiation oncology, diagnostic imaging, and biomedical technology, the examination process is getting tedious and challenging for the candidates.

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News from CAMPEP

Submitted by:
Ervin Podgorsak Ph.D. &
Peter Dunscombe Ph.D.

The Graduate and Residency Education Program Review Committees of the Commission on the Accreditation of Medical Physics Education Programs met in Houston from 7.30 – 9.30am on Sunday, 27th July, 2008. The primary business of these committees is to discuss applications for initial accreditation of graduate and residency programs in medical physics, evaluate re-accreditation applications of existing programs, and to consider possible updates in the CAMPEP guidelines.

The Board met from 3-5.30pm on Monday, 28th July. The Board receives reports from the two committees above plus the Continuing Education Program Review Committee and deals with financial and other operational issues. The initial part of the Board meeting is attended by several AAPM staffers. As noted previously, the AAPM headquarters makes very significant practical contributions to the operation of the CAMPEP. The Board is ultimately responsible for both approving changes in CAMPEP requirements and providing leadership in a changing environment.

From 7-9am on Tuesday, 29th July, the Board met with the three American Board of Radiology Trustees who represent the AAPM. The issue for discussion was, predictably, the challenges of complying with the recently approved ABR requirement that only those individuals who have successfully completed a CAMPEP accredited residency will be eligible to take the ABR certification examination beginning in 2014. Estimates of the number of qualified medical physicists per year required in the US are in the range of 200-300. Estimates of the number of graduates of CAMPEP accredited residency programs by 2012 are around 40-50. Clearly there is a disconnect. The major impediment to the opening of more training slots seems to be resources; the financial resources to remunerate residents and the institutional resources to run the program. There are at least two

(Continued on page 124)

Canadian College of Physicists in Medicine Examination Schedule 2009

Membership Examination:
Applications due: 5 January 2009
Examination date: Written 7 March 2009
Oral 8/9 May 2009 (Montreal)
Fee: $450.00
Entry decisions announced on or before February 20
(Note: Non-Radiation Oncology sub-specialty orals to be held at the same time as Fellowship orals)

Fellowship Oral Examination:
Applications due: 5 January 2009
Examination date: 1-2 days prior to COMP Meeting in Victoria (July)
Fee: $300.00
Entry decisions announced on or before February 20 (later for those who do the membership exam in the same year)

Note:

- The application forms, exam study guide, and sample exams are available on the CCPM website (http://www.ccpm.ca/) under the heading "CCPM Certification". Application forms must be the ones currently posted on the website.
- Membership & Fellowship examination application deadlines are set to the same date. This allows the Credentials Committee to review all applications in one time period.
- **It is critical for the success of your application that you respect the deadlines**.

For further information contact the Registrar:

CCPM Registrar
c/o P.O. Box 72024
Kanata North RPO
Kanata, ON K2K 2P4
Canada
Email: admin@medphys.ca

(Continued from page 123)
proposals under development for what are known as professional doctorate degrees. These comprise basically the didactic component of a CAMPEP approved Masters degree and the clinical training of a CAMPEP approved residency program. The essential difference between this approach and the current approach, apart from the title of the qualification, is that the student/resident bears the full financial responsibility for his/her education and training over probably 5 years. Thus, in principle, such an approach could remove the major impediment to the expansion of training slots, viz. resources, which would, in this model, be provided by the student. However, should such programs take off, it remains unclear as to where all these students could be placed for the clinical component of their training. There seemed to be no clear conclusion from this meeting apart from to continue to monitor the situation.

So, what needs to happen in Canada?

The COMP needs to consider the balance between the supply and demand of qualified medical physicists now and into the future.

Against this background, the CCPM needs to continue its discussion on the desirability and practical consequences of following the ABR exactly or considering alternative approaches, such as the less stringent requirement by which the exam candidates must have completed either a CAMPEP-accredited graduate program or CAMPEP-accredited residency,. and on the timeline of possible changes in requirements.

The objective, as always, is to ensure that safe, high quality radiation therapy can be planned and delivered to Canadian patients today and into the foreseeable future.

The CAP-COMP Peter Kirkby Memorial Medal for Outstanding Service to Canadian Physics

The CAP-COMP Peter Kirkby Memorial Medal recognizes outstanding service to Canadian physics. The medal is intended to recognize service to the physics community by strengthening the Canadian physics community, by enhancing the profession of physical scientists, by effectively communicating physics to the non-scientific community, or by making physics more attractive as a career. It is intended to provide a lasting memorial to Peter Kirkby and to recognize in others the qualities for which he is remembered best: a vision of a strong Canadian physics community, dedicated efforts to support that vision and, in all things, fairness, and honesty.

The Canadian Association of Physicists and the Canadian Organization of Medical Physicists have awarded the 2008 Peter Kirkby Memorial Medal to

Peter Calamai

National Science Reporter for The Toronto Star
for his exemplary communication of science to the public, for his dedication to the promotion of science through the media, and for his advocacy for science in Canada.

The Award was presented at the CAP Congress banquet 2008 June 10 in Quebec City.

The Peter Kirkby Memorial Medal was introduced in 1996 and is awarded biennially. The previous winners were:

- 2006 - Dr. Michael Steinitz, St. Francis Xavier University
- 2004 - Dr. Robert Barber, University of Manitoba
- 2002 - Dr. John R. (Jack) Cunningham, Camrose, Alberta
- 2000 - Dr. Paul Vincett, FairCopy Services Inc.
- 1998 - Dr. J.S.C. (Jasper) McKee, University of Manitoba
- 1996 - Dr. Donald D. Betts, Dalhousie University

The next medal will be awarded in the year 2010. The deadline for nominations will be January 8, 2010. Nominees must be members in good standing of the CAP or of COMP.

More information: http://www.cap.ca/awards/kirkby.html

Dates to Remember

Sept 29 -Oct3, 2008
5th Int'l Conference on Radiotherapy Gel Dosimetry;
Hersonissos, Crete, Greece

Sept 21-25 2008
ASTRO 2008, Boston MA

Oct 6-7, 2008
MRgFUS 2008 Symposium
Washington, DC, USA

Oct 19-24 2008
12th International Congress of IRPA
Buenos Aires, Argentina

Oct 19-25 2008
IEEE Nuclear Science Symposium & Medical Imaging Conference Dresden, Germany

Oct 20-24 2008
Joint ICTP-IAEA Activity on Imaging in Advanced Radiotherapy Techniques, Trieste, Italy

Nov 6, 2008
Physics and Engineering Aspects of PET/CT , London, UK

Nov 30—Dec 5 2008
RSNA, Chicago IL

Dec 11-13, 2008
ICMLA '08 - Special Session on Applications of Machine Learning in Radiotherapy
San Diego, CA, United States

Jan 24-29, 2009
BiOS 2009
San Jose, CA, United States

Apr 28– May 1, 2009
Radiobiology & Radiobiological Modelling in Radiotherapy
Chester, Cheshire, UK

May28-31, 2009
TCP Workshop
Edmonton AB

June 25-26, 2009
AAPM Summer School: Clinical dosimetry measurements in radiotherapy, Colorado College, USA

July 21- 24, 2009
2009 COMP Annual Scientific Meeting and CCPM Symposium
Victoria, B.C.

July 26-30 2009
2009 AAPM Annual Scientific Meeting
Anaheim, CA

Letter to the Editor: After the Enquiry-the CNSC/AECL Inquiry

Submitted by Alasdair Syme
Cross Cancer Institute, Edmonton AB

The extended shutdown in late 2007 of the National Research Universal (NRU) reactor at the Chalk River Laboratories (CRL) facility thrust the converging issues of radiation safety and health care into the public spotlight. Not surprisingly, after the reactor was restarted and isotope production had resumed, that spotlight faded faster than a proton PDD beyond the Bragg peak. While the public was no longer interested in the events, the parties directly involved in the incident were. An inquiry into the license renewal process and extended outage of the NRU reactor was commissioned by the CNSC and AECL. That report, entitled "*Atomic Energy of Canada Limited National Research Universal Reactor Safety System Upgrades and the Canadian Nuclear Safety Commission's Licensing and Oversight Process. A Lessons Learned Report*", was published in June 2008. The report was not intended to lay blame for the events, but rather to identify the deficiencies that led to the events and make recommendations about how to improve the performance of both organizations and the working relationship between them. The investigation was performed by Talisman International, LLC. It included reviews of documents, records, and correspondence as well as interviews with current and former CNSC and AECL staff and managers. Some of the findings of the report, particularly the underlying root causes of the problems, offer lessons of interest to the membership of COMP and are summarized below.

One of the fundamental observations made by Talisman was that "the CNSC regulatory program and the AECL regulatory compliance program are 'expert based' and not 'process based.' " They used these terms to denote a culture in which decisions with direct licensing implications were made at a local level (i.e. plant and project personnel at NRU as opposed to management at AECL), without formal incorporation into procedural documents. The consequences of some of these decisions were amplified by flawed communication pathways that existed within AECL and the CNSC and between AECL and the CNSC. For example, the connection of a hazards-qualified emergency power supply (EPS) to two main heavy water pumps (MHWP) was a task that was originally described as part of an EPS safety upgrade by AECL to the CNSC. Management at NRU made a decision (for which Talisman could find no documented rationale) to remove the EPS connection to the MHWPs from the scope of the EPS upgrade. The connection remained as an ongoing project, but one that was no longer tracked as part of the overall EPS upgrade, and consequently one with decreased importance and oversight. Furthermore, this decision was not communicated to either AECL's Safety Review Committee (SRC), a body that provided oversight of the EPS upgrade, or to the CNSC by NRU management. At the same time, some CNSC staff were aware of this change but they failed to elevate this decision to the attention of CNSC management. This led to discrepancies in licensing documents between the information provided by AECL about the physical state of the plant and the actual physical state of the plant. The lack of formal record keeping led to confusion between all parties and contributed significantly to the extension of the reactor shutdown.

"...the CNSC regulatory program and the AECL regulatory compliance program are 'expert based' and not 'process based.' "

Talisman felt that language also played an important role in the events. In particular, they felt that the CNSC had failed to use "clear, enforceable and understandable regulatory language necessary to impose specific requirements." The use of informal language in some regulatory documents may well have stemmed from the fact that the safety upgrades at the heart of the events of late 2007 were first brought to the attention of the CNSC (or more accurately, the Atomic Energy Control Board) back in 1992! In the fifteen years it took to complete the upgrades, they became known as "the seven safety upgrades." This phrase was used in licensing documents without a rigorous description of what was expected for each of the seven safety upgrades or what the consequences would be for failing to achieve them – a practice that Talisman found unacceptable from a regulatory body.

Why did it take so long for the upgrades to be completed? Talisman decided that both parties were responsible. For its part, the CNSC was not effective in enforcing its regulatory requirements. Despite discovering numerous instances of non-compliance, "the CNSC staff response has only been to request that AECL respond with plans and schedules for correction and upgrades." Consequently, "there is really no 'penalty' imposed by CNSC for failure to meet a regulatory requirement in most instances." It is potentially this lack of enforcement that helped foster a culture within AECL that AECL itself described as having "not consistently recognized or effectively dealt with those issues identified as significant by the regulator, in a timely manner." Talisman felt that the enforcement powers of the CNSC are too limited and they recommended that the CNSC should be given the power to levy monetary fines for non-compliance. Currently fines can be levied, but it requires the participation of the Department of Justice and they are seldom used. Providing this power to the CNSC would require parliamentary approval and changes to the Nuclear Safety and Control Act (NSAC). The CNSC is looking into this option.

Once the shutdown of the reactor had been initiated it took too long to get it restarted. The report found that part of this long shutdown duration was due to the fact that the CNSC staff who were familiar with the safety upgrades did not have the authority to grant a license amendment that would permit operation of NRU in its current physical state. As a result, they were forced to prepare background materials and a safety case that could be submitted to the Commission for review. Talisman recommended that the CNSC delegate sufficient authority such that the issuance of a license amendment does not necessarily require review by the full Commission. They also suggested that the CNSC and AECL should "develop a formal process to promptly determine whether, and under what condi-

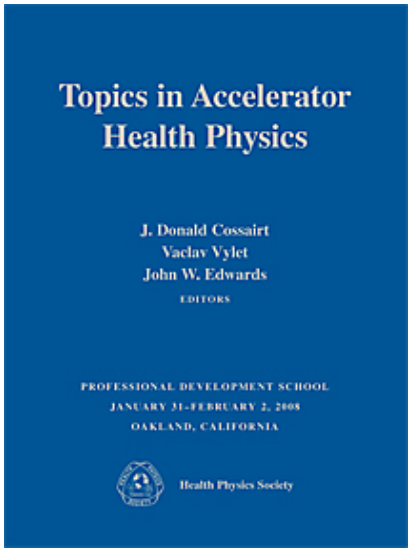
(Continued on page 128)

Book Review

Topics in Accelerator Health Physics

Editors:
J. Donald Cossairt
Vaclev Vylet
and John W. Edwards

Submitted by:
Marc MacKenzie, Ph.D.
Cross Cancer Institute, Edmonton AB



309 pages

ISBN: 978-1-*930534-37-8 (paperback)

$50.00 USD

"Topics in Accelerator Health Physics" is a recently published compendium from the U.S. Health Physics Society (USHPS) of material originally presented at their Professional Development School, held in January, 2008 Oakland, CA. The presenters were current or retired professionals from various national labs or university based research accelerators (TRIUMF, SLAC, Los Alamos, Argonne, Fermi, Loma Linda, Thomas Jefferson, and Pacific NW).

After an initial general chapter on accelerator physics for health physicists, other chapters covered some pertinent fundamental radiation physics, practical topics and professional / administrative topics. The general accelerator physics of interest to health physicists included topics such as mechanisms of prompt and induced radioactivity, as well as mechanisms of radiation damage to materials. Practical topics covered include such topics as monitoring (area, personnel and environmental), shielding / shielding codes, and new accelerator facility design. Professional or administrative topics covered included general safety systems and health physics program administration, as well as regulatory issues. There are also general overview chapters describing synchrotron facilities, free electron lasers, accelerators specifically for radiation therapy, as well as new and emerging technologies.

While the topics covered will doubtless be of interest to health physicists working at both research and industrial facilities, some of this collection is of a slightly more academic bent than what the more clinically oriented health physicists will likely encounter in their routine work. The academic tone of some chapters may, however, make it ideal for health physics professionals who are trying to brush up on their fundamentals.

The more technical chapters do not shy away from either the appropriate formulae or graphs, and these chapters are followed by chapters that are more administrative in tone, describing radiation safety programs, monitoring and response to incidents. The case studies in the chapter on Health Physics Program Management were particularly interesting. Some chapters are extensive, perhaps a little excessively so, whereas other (Environmental Monitoring, for example) are given short shrift, but on balance this collection appears to provide a good overview of topics of interest to health physicists.

One issue from a Canadian perspective is that, being a publication from the USHPS, the emphasis is naturally on US regulations and regulatory bodies, and there is some attention to "homeland security" issues. Nevertheless, general principles will still be universally applicable.

Although its breadth of coverage of different accelerators, and depth coverage of underlying physics, may exceed what is required by many health physicists day to day, it can nevertheless serve as a good broad reference for members of the larger medical physics community, especially if one is interested in topics not often covered elsewhere such as prompt activation or radiation damage to materials. If one is looking for a reference text for accelerator theory, however, there are better texts available.

In summary, this collection is quite likely an ideal reference for the health physicist working in a mixed administrative / research position in the United States, and a reasonably good reference for any medical physicist with radiation safety duties. It may still be of interest to other medical physicists, but there may be other reference texts that would serve them better, depending on their specific interests.

(Continued from page 113)

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… the CNSC/AECL Inquiry

(Continued from page 126)

tions, continued NRU reactor operation may be justified during off-normal conditions."

Many of the findings in the report are specific to the NRU and AECL, but the underlying theme is that a strong radiation safety program that adheres to the ALARA principle is critical for the smooth operation of a nuclear facility. In this particular case, Talisman found that record keeping, staff training and management control over work practices were all deficient (in both AECL and the CNSC). The findings of the report were generally accepted by AECL and the CNSC. Their responses to the recommendations were included in the report (which is available at www.nuclearsafety.gc.ca/) and both organizations have already taken steps to improve their operations.

This is not the last time we will be hearing about the NRU reactor. The purpose of the extension of the lifetime of the reactor was to allow enough time for the MAPLE reactors that were intended to replace NRU to come online. Since AECL has now ceased development work on those reactors the ALARA debate will no doubt surface again in 2011 when the current operating license expires.

(Continued from page 114)

♦ To the question: **"*What would improve your conference experience?*,** excellent suggestions were made for both the logistics and the conference program. Generally speaking, respondents prefer a single site for both the scientific program and the accommodations and prefer that the accommodations be located closer to downtown. It was suggested that there should be more balance in the program between imaging, radiotherapy and radiation safety, more time for posters and an opportunity for more presentations/ workshops from senior medical physicists.

We would like to thank you once again for participating in the survey. We will use the information gathered as we prepare for the 2009 meeting. If you would like to see the full results of the survey, please contact Nancy Barrett at 613-599-1948 or nancy@medphys.ca.

...CNSC Feedback Forum

(Continued from page 92)

However, the application must include some elements of the information which would normally be part of an application for a licence to construct, namely the physical description of the facility showing siting of the new equipment, the anticipated radiological workload, and a reassessment of the shielding design (see C120 section G). You must also submit a full description of all of the various safety systems to be used in conjunction with the new equipment (see C120 section H).

Note that, as discussed in the April 2008 edition of Interactions, ***the shielding assessment can be based on the actual dose rates measured outside the facility using the previous machine.*** For older facilities, which were designed and built prior to the enactment of the NSC Act and the Class II Regs, it is possible that the existing shielding may not be sufficient to achieve the typical design dose targets used for new facilities. These situations will be evaluated on a case by case basis, considering the magnitude of the doses and the cost and implications of possible dose reduction measures.

Finally, ***we're only interested in the new equipment and the room(s) in which it is being installed***. The information you submit in the application doesn't have to cover any of your other existing facilities (e.g., please don't give us a laundry list of every facility you operate in section C of the licence application form). The more irrelevant material included in the application, the more difficult and time consuming it is to assess.

Q) We're decommissioning a cobalt teletherapy unit and want to re-use the vault as an HDR afterloader facility. What types of licences do I need to do this and what information must I submit?

This is handled in a manner very similar to that described above. In most cases, since the room is already built, you can apply directly for a commissioning licence for the HDR unit. Again, you'll need to provide a physical description of the facility showing siting of the new equipment, the anticipated radiological workload and a full description of all of the various safety systems to be used in conjunction with the new equipment.

As for the shielding design, we recognize that a cobalt teletherapy room is likely to have far greater shielding than is required for an HDR unit. However, some form of dose estimate for persons occupying adjacent areas is required for confirmation. Siting of the HDR may have an impact (e.g., if it were to be situated in direct line-of-sight from the door). Many licensees take the opportunity at this point to demonstrate by calculation that even for the highest possible projected workload, the shielding is sufficient for full occupancy by the general public in all surrounding areas. This helps to eliminate any future concerns regarding increased workload or changes in occupancy, both from the perspective of the regulator and facility staff.

Q) We want to install the latest and greatest major accessories on our accelerator. Does this require a licence amendment?

The first issue is, were they included under the CNSC prescribed equipment Certification issued to the manufacturer for that model of accelerator? If not, they cannot legally be installed until the manufacturer applies for and receives a new certificate.

As for licensing, LC2917 effectively does not allow the equipment to be modified into configurations that were not described in the original license application. Consequently, such modifications generally require approval. In many cases this just means adding a letter from the licensee describing the proposed modifications to the *Appendix: Licence Document(s).* However, if the upgrade results in modifications to the existing safety systems to allow for the addition of supplementary safety interlocks; (e.g.: installation of an OBI system to the gantry of an accelerator), then the normal route is to add a new condition to the licence which temporarily restricts operation to commissioning only. The condition is then removed upon submission of a commissioning report confirming that all of the safety systems were tested and functioning properly following completion of the upgrade. It is important to note that this is normally not a lengthy or involved process. We recognize that machine upgrades are part of the normal evolution of a clinic as new technology becomes available and consequently we always try to be as expeditious as possible to minimize the down time of the facility.

Head, Department of Medical Physics

Location: Odette Cancer Centre, Sunnybrook Health Sciences Centre Toronto, Ontario, Canada

Sunnybrook Health Sciences Centre (SHSC) is seeking an innovative, academic leader in medical radiation physics to be head of the Department of Medical Physics. SHSC is an academic health sciences centre fully affiliated with the University of Toronto located in north-central Toronto. The Odette Cancer Centre is the comprehensive cancer program of SHSC and one of the largest cancer centres in Canada. The successful candidate will provide strategic and operational direction for all academic, clinical, and administrative functions for the Department. He/she will work collaboratively with the Head of the Department of Radiation Oncology and the Head of the Department of Radiation Therapy to oversee the direction and management of the Radiation Treatment Program.

Over 6000 new radiation oncology patients are seen each year at the Odette Cancer Centre. This state-of-the-art radiation therapy facility is equipped with 12 linear accelerators, 1 Tomotherapy, 3 CT simulators and 1 PET/CT simulator. Planning systems include Pinnacle, MMS, Plato, and Xplan. The centre has an extensive brachytherapy program with an on-site surgical suite. There are future plans for a major expansion to the suite with a second OR and research laboratory. The centre offers advanced clinical and research programs in IMRT, IGRT, SRS, and SBRT.

The Medical Physics Department comprises 17 medical physicists, 5 physics associates, 13 engineering staff, 2 research radiation therapists, 1 assistant radiation safety officer, 3 computer systems staff, 4 residents in the CAMPEP accredited residency training program, as well as 2 administrative support staff.. As the professional practice leader of Medical Physics, the head oversees all the professional staff in the department with appointments to the Departments of Radiation Oncology and Medical Biophysics at the University of Toronto.

SHSC provides an exciting and dynamic research environment for physicists to work alongside a diverse group of health care professionals. There are multi-disciplinary research programs in radiation target definition (anatomic and molecular imaging), verification imaging, novel detector design, brachytherapy, and ultrasound. Plans are underway to install a 3T MR in the radiation planning area with a focus on anatomic and molecular imaging and simulation for oncology.

Adjacent to the cancer centre, the Sunnybrook Research Institute (SRI) houses some of the world's most renowned scientists in imaging, molecular & cellular biology, and clinical epidemiology. Fully affiliated with the University of Toronto, scientists at SRI currently mentor over 133 graduate students and 140 post-doctoral fellows.

The successful candidate will have a Ph.D. and will be a certified medical radiation physicist with an outstanding academic and administrative record, and eligible for appointment at the rank of Associate Professor or Professor in the Department of Radiation Oncology, University of Toronto. Salary and benefits will be consistent with the senior level of this position.

Contact: Shun Wong, M.D.,
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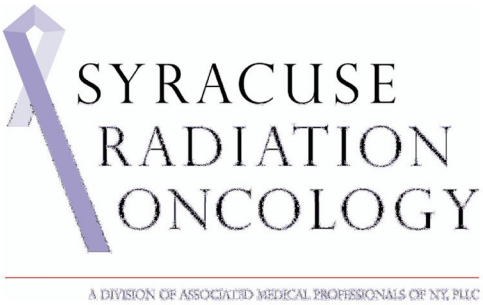

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For further details on the post, please contact Debbie Zehel, Radiation Administrator – email: debbiez@syrradonc.com or phone 315-478-3468. Please email curriculum vitae to this address or hard copy to:

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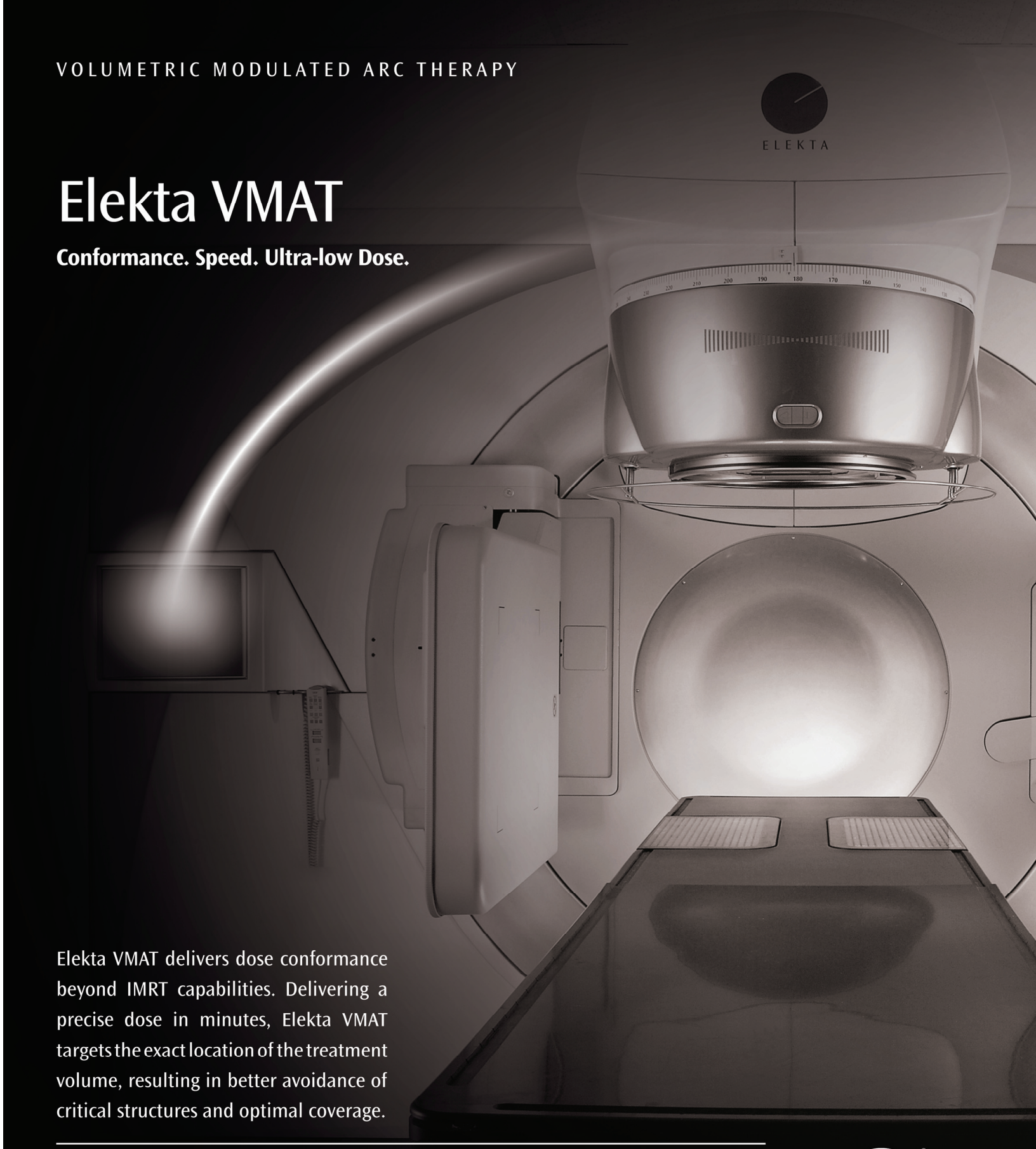

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