Ottawa Medical Physics Institute (OMPI)

A Carleton University Research Centre
based in the Department of Physics,
Carleton University, Ottawa, Canada

physics.carleton.ca/ompi

Annual Report # 24

2011 September 1 – 2012 August 31

Submitted by Malcolm McEwen, PhD, OMPI Director.

Contents

1. *Editorial*

In 1987 the rock band U2 released their seminal album "The Joshua Tree". One of the perhaps lesser known tracks (but still worth a listen) is titled "Running to Stand Still" and I was reflecting that this is an accurate description of what medical physicists do on a day-to-day basis. There is so often a focus on moving forward with new developments and exciting projects (and Annual Reports can be especially guilty of this) that we get the impression that standing still is a failure, or suggests a lack of ambition or ability. On the contrary, simply doing the same thing day after day requires significant effort, ability and concentration. This is especially true when you are dealing with complex equipment capable of imaging tumours with amazing detail or delivering cancer-killing radiation with a precision of a few millimetres. In the field of radiation therapy it is of vital importance that what was done yesterday can be repeated today – a patient receiving a 6-week treatment for cancer wants to know that the people carrying out the procedure are not trying something different every day but are being consistent in the delivery of radiation to the tumour. Clinical trials, which are the gold standard for evaluating treatment techniques, require that the same procedure is carried out for multiple patients in multiple locations.

So, although much of the text below highlights the "new", we implicitly celebrate the "same" and in doing so recognize the many medical physicists in the Ottawa region that ensure that is the case.

2. *Membership*

We welcomed three new members this year:

Rolf Clackdoyle is an imaging scientist with a focus on CT. Dr Clackdoyle organized a short summer course in 2011 on methods of image reconstruction and this was well attended by students and other interested researchers from the Ottawa area.

Greg Cron is a Senior Clinical Research Associate in the Ottawa Health Research Institute at The Ottawa Hospital carrying our research using MR imaging to determine blood flow. It is hoped that such perfusion measurements can indicate the activity of tumours and therefore assist in cancer diagnosis.

Raphael Galea is a Research Officer in the Ionizing Radiation Standards group at NRC and heads up the radioactivity metrology laboratory. He has played a crucial part in the Ottawa collaboration that demonstrated the production, extraction and delivery of the important imaging isotope Tc-99m using a non-reactor source.

3. *Graduate Program*

One of the prime activities of OMPI members is to coordinate and deliver the MSc and PhD programs in medical physics within the Physics Department at Carleton University.

This academic year, in the fall term Paul Johns gave our foundation course, *Medical Radiation Physics,* Tong Xu taught *Physics Applications of Fourier Analysis* and the *Computational Physics* course was taught by Manuela Vincter. In the winter term, *Radiotherapy Physics* was taught by Dave Rogers and *Radiation Protection* was taught by David Wilkins (coordinator) and Pat Saull. Thank you to all those who taught in our program, especially those from outside Carleton who made the time available to benefit our students.

In November 2011 we held a symposium on Professionalism and Ethics. David Wilkins, then President of the CCPM, gave a talk on "Medical Physicist Certification in Canada" and David Rogers, Deputy Editor of *Medical Physics* gave a talk on "Writing and reviewing papers for the journal Medical Physics" which was followed by a vigorous discussion of various ethical issues based on the joint AAPM, ABR, ACR, ARS, ASTRO and RSNA on-line modules on "Ethics and Professionalism".

Table 3 lists the graduate students in the program and Table 4 lists those who completed their theses with the year of this report. An indication of the good links developed through OMPI is that two of those candidates – Amanda Cherpak and Elsayed Ali – were accepted into the residency program at The Ottawa Hospital Cancer Centre. Irrespective of their next destination we wish all these Carleton graduates a hearty "well done"!

4. *Seminars*

The monthly OMPI seminars (Table 5) continue to be well attended. Students are expected to give regular presentations during their program (at least once for M.Sc. students, 2 or 3 times for Ph.D.'s). This is excellent practice for both conference presentations and career development. Members give seminars on a rolling schedule, typically every three years or so. Thank you to all speakers and attendees.

Table 6 lists the 2011-2012 medical physics component of the regular weekly seminar series of the Carleton University Department of Physics.

5. *OMPI News and Events*

External teaching activities

Beyond the graduate program at Carleton, OMPI members presented their work to a wide range of audiences all over Canada and the rest of the world. It is difficult to capture all these activities in one paragraph but it is interesting to note that many OMPI members spend significant time explaining their work to others in the medical field in Ottawa, with lectures and teaching activities for Ottawa Hospital fellows and residents, for departments in the Faculty of Medicine at the University of Ottawa, etc. It is not only the number that is important; many of these are continuing activities, which speak to their value.

People

Drs **Brenda Clark** and Joanna Cygler were appointed as full professors with the Department of Radiology at the University of Ottawa. This is a significant accomplishment for two people who have contributed significantly to field of clinical medical physics. Both Brenda and Joanna are also adjunct professors in the Department of Physics at Carleton University.

In May 2012, Dr **Ruth Wilkins** at the Radiation Protection Bureau of Health Canada received the Assistant Deputy Minister Award of Excellence in recognition of her world-leading work in the field of emergency personal dosimetry.

At the Canadian Organization of Medical Physicists' Annual Meeting, Dr **David Rogers** of Carleton University was awarded the COMP Gold Medal – the highest award the organization can bestow. In addition, COMP also introduced the award of FCOMP (Fellow of COMP) to recognize those who have contributed significantly to medical physics over the course of their careers. Among those first awardees was Dr **Paul Johns** of Carleton University.

Dr **Rowan Thomson** of Carleton University received the 2011 Council of Ontario Universities' John Charles Polanyi Prize in Physics.

National and International Activities

During the past academic year many OMPI members served on various national and international committees. A small selection is listed below but many of those listed in previous annual reports continue to serve:

Steering Committee member of the WHO International Biodosimetry Network – Ruth Wilkins
CCO (Cancer Care Ontario) Physics Provincial Advisory Committee – Brenda Clark
IAEA (International Atomic Energy Agency) Committee on In-vivo dosimetry – Joanna Cygler
CMA (Canadian Medical Association) Committee on Program Accreditation – Ian Cameron
AAPM (American Association of Physicists in Medicine) Calibration Accreditation Subcommittee – Malcolm McEwen
Medical Physics journal (deputy editor) – David Rogers
CCPM (Canadian College of Physicists in Medicine) – David Wilkins (President)

6. *OMPI Executive*

I would like to thank the following for serving on the Executive in 2011-2012: Dave Rogers (Academic Officer), Rob deKemp (Past-Director), and Richard Wassenaar (Secretary). When Richard stood down as Secretary, Nic Ploquin kindly volunteered for the position, but had to resign three months later after accepting a new position in Calgary. The position of Communications Officer was officially created and Tong Xu was appointed to that role. Thanks, finally, to Bryan Muir for representing the students, and to our observers, Brenda Clark (TOHCC), Trevor Stocki (Health Canada) and Paul Johns (Carleton U).

7. *OMPI Website*

The OMPI maintains a website with detailed information on the organization, its members, students and alumni, seminars and research areas. Please visit ***http://physics.carleton.ca/ompi***.

Table 1. OMPI Members, 2011-2012.
For details see ***http://physics.carleton.ca/ompi*** and select Members/Students.

	Member	Institution and Unit	Specialization within Medical Physics
1	Lesley Buckley	Department of Medical Physics, The Ottawa Hospital Cancer Centre	Radiotherapy
2	Ian Cameron	Diagnostic Imaging, The Ottawa Hospital	MRI
3	Rolf Clackdoyle	CNRS, Saint Etienne, France	Mathematics of imaging
4	Brenda Clark	Department of Medical Physics, The Ottawa Hospital Cancer Centre	Radiotherapy
5	Claudiu Cojocaru	Ionizing Radiation Standards, Institute for National Measurement Standards, NRC	Radiotherapy and radiation dosimetry
6	Greg Cron	Diagnostic Imaging, The Ottawa Hospital	MRI
7	Joanna Cygler	Department of Medical Physics, The Ottawa Hospital Cancer Centre	Radiotherapy
8	Rob deKemp	Cardiac PET Centre, Univ. of Ottawa Heart Institute	PET
9	Costel Flueraru	Microstructural Sciences, NRC	Optical coherence tomography
10	Raphael Galea	Ionizing Radiation Standards, NRC	Radioactivity metrology
11	Lee Gerig	Department of Medical Physics, The Ottawa Hospital Cancer Centre	Radiotherapy
12	Elizabeth Henderson	Department of Medical Physics, The Ottawa Hospital Cancer Centre	Radiotherapy
13	Bog Jarosz	Retired from Dept. of Physics, Carleton University	Ultrasound thermal therapy
14	Paul Johns	Department of Physics, Carleton University	X-ray imaging
15	Dmitry Y. Klokov	Radiological Protection Research and Instrumentation, AECL, Chalk River Laboratories	Radiobiology
16	Malcolm McEwen	Ionizing Radiation Standards, Institute for National Measurement Standards, NRC	Radiation dosimetry
17	Cheng Ng	Retired from Ottawa Hospital Research Institute	Radiobiology and hyperthermia
18	Balazs Nyiri	Department of Medical Physics, The Ottawa Hospital Cancer Centre	Radiotherapy
19	Nicolas Ploquin	Department of Medical Physics, The Ottawa Hospital Cancer Centre	Radiotherapy
20	G. Peter Raaphorst	Retired from The Ottawa Hospital Cancer Centre; Consultant medical physicist.	Radiobiology and hyperthermia
21	Richard Richardson	Radiation Biology & Health Physics, Chalk River Laboratories, AECL	Radiation physics and radiation protection
22	David Rogers	Department of Physics, Carleton University	Radiotherapy and radiation dosimetry
23	Carl Ross	Ionizing Radiation Standards, NRC	Radiation dosimetry
24	Gabriel Sawakuchi	Department of Physics, Carleton University	Radiotherapy
25	Laurel Sinclair [§]	Earth Sciences Sector, Natural Resources Canada	Detection of radiological threats
26	Trevor Stocki	Radiation Protection Bureau, Health Canada	Health physics
27	Janos Szanto	Department of Medical Physics, The Ottawa Hospital Cancer Centre	Radiotherapy
28	Frédéric Tessier	Ionizing Radiation Standards, Institute for National Measurement Standards, NRC	Radiation dosimetry
29	Rebecca Thornhill	Diagnostic Imaging, The Ottawa Hospital	MRI
30	Rowan Thomson	Department of Physics, Carleton University	Radiotherapy and radiation dosimetry
31	Eric Vandervoort	Department of Medical Physics, The Ottawa Hospital Cancer Centre	Radiotherapy
32	Julia Wallace	Department of Physics, Carleton University	MRI
33	Richard Wassenaar	Best Theratronics	Nuclear medicine imaging
34	Glenn Wells	University of Ottawa Heart Institute	Nuclear cardiology
35	David Wilkins	Department of Medical Physics, The Ottawa Hospital Cancer Centre	Radiotherapy
36	Ruth Wilkins	Consumer & Clinical Radiation Protection Bureau, Health Canada	Radiobiology
37	Tong Xu	Department of Physics, Carleton University	Positron emission tracking (PeTrack)

[§]Associate Member

Table 2. OMPI Executive, 2011-2012.

Position	Member		Position	Member
Director[§]	Malcolm McEwen		Student Representative[†]	Bryan Muir
Past-Director[§]	Rob deKemp		Seminar Organizer	Claudiu Cojocaru
Academic Officer[§]	David Rogers		Communications Officer	Tong Xu
Secretary[§] (Sep-March)	Richard Wassenaar		Observer – TOHCC	Brenda Clark
Secretary§ (March – June)	Nicolas Ploquin		Observer – Health Canada	Trevor Stocki

[§]position elected by the members
[†]position elected by the medical physics graduate students

Table 3. Graduate Students in Medical Physics, 2011-2012.
For details see **http://physics.carleton.ca/ompi** and select Members/Students. A list of Past Graduates is also available.

	Student	Program	Supervisor	Project Area
1	Elsayed Ali [¶]	Ph.D.	Dave Rogers	linac spectral measurements
2	Lindsay Beaton	Ph.D.	Ruth Wilkins	markers for radiosensitivity
3	Jason Bélec [¶]	Ph.D.	Brenda Clark	Elekta radiotherapy
4	Marc Chamberland	Ph.D.	Tong Xu	PeTrack algorithm development
5	Amanda Cherpak [¶]	Ph.D.	Joanna Cygler	radiation dosimetry applications of RADPOS
6	Stéphanie Chiasson	M.Sc.	Glenn Wells	dual isotope SPECT corrections and clinical applications
7	Tyler Dumouchel [¶]	Ph.D.	Rob deKemp	small-animal PET
8	Matthew Efseaff [¶]	M.Sc.	Rob deKemp	precision of myocardial blood flow measurement with ^{82}Rb PET
9	Islam El Gamal	M.Sc.	Malcolm McEwen	Fricke dosimetry for HDR brachytherapy
10	Dal Granville	Ph.D.	Gabriel Sawakuchi	OSL/proton therapy
11	Chad Hunter	Ph.D.	Rob deKemp	dynamic PET motion correction
12	M. Shoaib Khan	M.Sc.	Laurel Sinclair	Compton camera for nuclear security
13	Michel Lalonde	Ph.D.	Richard Wassenaar & Glenn Wells	Nuclear medicine: cardiac dyssynchrony
14	Karl Landheer [¶]	M.Sc.	Paul Johns	collimation design optimization for x-ray scatter imaging
15	Marielle Lespérance	M.Sc.	Rowan Thomson	Cellular dosimetry for keV radiation
16	Conor McFadden	M.Sc.	Gabriel Sawakuchi	Fluorescence nuclear track detectors for microdosimetry
17	Nelson Miksys	Ph.D.	Rowan Thomson	Monte Carlo dose calculations for brachytherapy
18	Bryan Muir	Ph.D.	Dave Rogers	rad. dosimetry: calculating beam quality conversion factor k_Q
19	Azeez Omotayo [¶]	M.Sc.	Gabriel Sawakuchi	in-vivo dosimetry using OSLD's
20	Elizabeth Orton	Ph.D.	Glenn Wells	motion correction for cardiac SPECT
21	Amir Pourmoghaddas	Ph.D.	Glenn Wells	absolute flow measurement in clinical cardiac SPECT
22	Matthew Rodrigues	Ph.D.	Joanna Cygler	clinical applications of RADPOS to IMRT
23	Hong Shen	M.Sc.	Carl Ross	wide-angle free air chamber for brachytherapy seeds
24	Benjamin Spencer [¶]	M.Sc.	Tong Xu	coregistration of PeTrack with x ray
25	Jared Strydhorst	Ph.D.	Glenn Wells	Reconstruction algorithm for μSPECT
26	Justin Sutherland	Ph.D.	Dave Rogers & Rowan Thomson	MC dose calculations for brachytherapy
27	Rachel Timmins [¶]	M.Sc.	Glenn Wells	small-animal dual-isotope SPECT
28	Brandon Zanette	M.Sc.	Ian Cameron	Dynamic contrast enhanced MRI of gliomas

[¶] Degree completed between 2011 September 1 and 2012 August 31 (defence may have been 10 days later); see Table 4.

Table 4. Theses Completed, 2011-2012. Ordered by date of defence.

Student	Degree	Supervisor	Thesis Title and Date of Defence
Amanda Cherpak	Ph.D.	Cygler	Dose and position measurements using a novel 4D in vivo dosimetry system Nov 17, 2011 External Examiner: George Ding, Vanderbilt Univ.
Tyler Dumouchel	Ph.D.	deKemp	Partial volume correction of cardiac mouse positron emission tomography images Nov 29, 2011 External Examiner: Andrew Reader, McGill Univ. & Montreal Neurological Inst.
Azeez Omotayo	M.Sc.	Sawakuchi	Characterization of aluminium oxide optically stimulated luminescent dosimeters for clinical dosimetry in radiotherapy Aug 13, 2012
Ben Spencer	M.Sc.	Xu	Three-dimensional co-registration between a positron emission tracking system and a C-arm x-ray imaging system Aug 13, 2012
Karl Landheer	M.Sc.	Johns	Synchrotron-based coherent scatter x-ray projection imaging using an array of monoenergetic pencil beams Aug 14, 2012
Rachel Timmins	M.Sc.	Wells	Dual isotope cross-talk correction in Tc-99m/In-111 small-animal SPECT Aug 24, 2012
Elsayed Ali	Ph.D.	Rogers	Accurate unfolding of clinical photon spectra from transmission measurements Sept 5, 2012 External Examiner: John Schreiner, Queen's University
Matthew Efseaff	M.Sc.	deKemp	Test-retest repeatability of myocardial blood flow measurements using Rubidium-82 Positron Emission Tomography Sept 5, 2012
Jason Bélec	Ph.D.	Clark	Monte Carlo calculation of volumetric modulated arc therapy and helical tomotherapy dose distributions for stereotactic ablative radiotherapy lung treatments Sept 10, 2012 External Examiner: Eugene Wong, Western University

Table 5. OMPI Seminars, 2011-2012.
For details see http://physics.carleton.ca/events/all/ottawa-medical-physics-institute.

Date / Location	Speakers and Titles
Sept 29, 2011 Carleton University	Azeez Omotayo: Characterization of sensitivity changes of nanoDot OSLDs exposed to 6 MV x-ray beams Ian Cameron: Evaluation of diffusion and diffusion-like motion in human subjects using MRI Followed by an OMPI social on Bank Street.
Oct 20, 2011 Ottawa Cancer Centre	Karl Landheer: Coherent scatter ring integration imaging Bog Jarosz: Computations of temperature patterns in interstitial thermal therapy
Nov 17, 2011 Health Canada	Benjamin Spencer: Distortion correction, geometric calibration, and volume reconstruction for an isocentric c-arm x-ray system Janos Szanto: CyberKnife: one year later
Dec 15, 2011 University of Ottawa Heart Institute	Matthew Efseaff: Repeatability of short term quantitative resting myocardial blood flow measurements using rubidium-82 PET imaging Rolf Clackdoyle: Reduced radiation dose using software techniques?

Jan 19, 2012 Ottawa Cancer Centre	Stéphanie Chiasson: Crosstalk corrections using a triple energy window (TEW) method in dual-isotope cardiac SPECT imaging on a dedicated CdZnTe camera Dave Rogers: The value of $(W/e)_{air}$ and its importance to ion chamber dosimetry
Feb 16, 2012 Carleton University	Shoaib Khan: Source localization using directional gamma ray spectrometer Rob deKemp: Rubidium-82 PET alternative to Tc-99m SPECT for myocardial perfusion imaging
March 22, 2012 Health Canada	Rachel Timmins: Cross-talk correction in dual isotope $^{111}In/^{99m}Tc$ small animal SPECT imaging Gregory Cron: Vascular input functions measured using MRI phase
April 19, 2012 University of Ottawa Heart Institute	Marc Chamberland: Performance evaluation of real-time motion tracking using positron emission fiducial markers Lesley Buckley: Evaluating new techniques to improve adaptive radiotherapy
May 17, 2012 NRC IRS	Elizabeth Orton: Interference of abdominal activity in 82-Rb PET myocardial perfusion imaging Raphael Galea: Reduce, reuse and recycle: A green solution to Canada's medical isotope shortage Followed by the annual BBQ

Table 6. Carleton University Department of Physics Seminars in Medical Physics, 2011-2012.
Departmental seminars on medical physics topics. For a complete list, see ***http://physics.carleton.ca/colloquium*** .

Date	Speaker, Institution, and Title
Nov 8, 2011	Issam El Naqa, McGill University Interfacing physics and biology by system-based computational modeling in radiation oncology: Prospects and challenges
Nov 22, 2011	Harald Paganetti, Harvard Medical School/Massachusetts General Hospital Physics challenges in proton therapy
Dec 8, 2011 OCIP Fall Graduate Student Seminars	Justin Sutherland Model-based dose calculations for I-125 lung brachytherapy implants Jason Bélec Monte Carlo simulations of dynamic external beam photon treatments Jared Strydhorst Quantitative small-animal micro-SPECT with attenuation correction and scatter compensation
Dec 13, 2011 OCIP Christmas Symposium	Rob de Kemp, University of Ottawa Heart Institute, Rubidium-82 alternative to Technetium-99m for cardiac blood flow imaging
Jan 5, 2012	Jennifer McNab, Athinoula A.Martinos Center for Biomedical Imaging, Harvard Medical School Developing MRI technology to study changes in the architecture of the in vivo human cerebral cortex
Jan 9, 2012	Andrew Goertzen, Department of Radiology, University of Manitoba Detector development for compact and multimodality Positron Emission Tomography (PET) imaging systems
Jan 17, 2012	Sara St. James, Harvard Medical Physics Residency Program, Harvard Medical School Instrumentation to improve the spatial resolution and sensitivity in small animal PET

Jan 31, 2012	William T. Diamond, Emeritus, Atomic Energy of Canada Limited, Chalk River Laboratories Accelerator production of the medical isotope Tc-99m
April 3, 2012 CAP Lecture	Paul Higgs, Physics Department, McMaster University Efficiency in the cell: How cells make proteins rapidly while working to a budget
April 17, 2012	Rolf Clackdoyle, Directeur de recherche, Laboratoire Hubert Curien, CNRS Univ. Jean Monnet Centers and centroids of the projection of a sphere
May 2, 2012 OCIP Spring Graduate Seminars I	Ben Spencer Volumetric x-ray imaging with isocentric C-arm Stéphanie Chiasson Tc-99m/Tl-201 crosstalk correction on a dedicated cardiac CZT SPECT camera Rachel Timmins Dual isotope cross-talk correction in quantitative small animal SPECT imaging Karl Landheer Coherent x-ray scatter projection imaging using an array of mono-energetic pencil beams
May 8, 2012 OCIP Spring Graduate Seminars II	Matthew Efseaff Test-retest repeatability of myocardial blood flow measurements using Rb-82 PET imaging Shoaib Khan Source localization using directional gamma ray spectrometer Lindsay Beaton Predicting patient radiosensitivity: Looking for biomarkers in human leukocytes following ionizing radiation Azeez Omotayo Investigation of calibration protocols for nanoDot optically stimulated luminescent detector (OSLD) use in clinical radiotherapy dose measurements
May 10, 2012	Costel Flueraru, Inst. Microstructural Sciences, NRC Bio-medical optics: Spectroscopic optical coherence tomography
May 16, 2012	Laurel Sinclair, Geological Survey of Canada, Natural Resources Canada Characterization of radiation in the environment