Ottawa Medical Physics Institute (OMPI)

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

www.physics.carleton.ca/ompi

Annual Report # 19
2006 July 1 – 2007 June 30

Submitted by Malcolm McEwen, PhD, OMPI Director.

Introduction

Medical physicists are applied scientists who use the tools of physics to improve health care. Although physicists can be found involved in almost all aspects of health care medical physics as a practice usually refers to three areas - cancer therapy, medical biophysics, and imaging. Over the years medical physicists have developed such revolutionary technologies as photon and electron cancer treatment machines, and CT, PET, and MR imagers. It is difficult to imagine modern medicine without these technologies and it is indisputable that medical physics has brought large improvements to patient care.

The Ottawa Medical Physics Institute (OMPI), founded in 1989, is based in of the Department of Physics of Carleton University in Canada's capital city, Ottawa. It is a network of approximately 30 medical physicists in the Ottawa region who are active in research, teaching and graduate student education. The Ottawa medical physics community has one of the most diverse spectra of research and service activities in Canada. Our members are located at The Ottawa Hospital and Regional Cancer Centre, the University of Ottawa Heart Institute, Health Canada, the National Research Council of Canada (NRC), Atomic Energy of Canada Limited (AECL) Chalk River Laboratories, and Nucletron Canada, as well as at Carleton University. 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 Annual Report summarizes our activities during the 2006-2007 academic year.

Members of OMPI have been awarded research funding by the Natural Sciences & Engineering

Research Council (NSERC), the National Cancer Institute of Canada (NCIC), the Canadian Institutes of Health Research (CIHR), the Heart & Stroke Foundation, the Canadian Breast Cancer Research Initiative, the Canada Foundation for Innovation (CFI), the federal Chemical, Biological, Radiological and Nuclear (CBRN) Research Technology Initiative (CRTI), the Health Technology Exchange of the NRC Industrial Research Assistance Program (HTX-IRAP) and others. OMPI scientists also participate in research consortia such as Imaging Network Ontario and their research is supported through a variety of industrial collaborations.

Membership

Table 1 summarizes our membership, which at year's end numbers 28, and Table 2 lists the Executive of the organisation. Our members' activities span the field of medical physics, including cancer therapy physics (14 members), imaging (7), and radiobiology and health physics (6). Complete profiles are given on the website. Another three new members were welcomed into OMPI this year:

Tong Xu – is Assistant Professor at Carleton University and joined the faculty in early 2006. Tong's primary research interest is real-time tumour tracking using implanted positron emission markers for accurate radiation therapy.

Glenn Wells – is a researcher at the University of Ottawa Heart Institute, having previously worked at the Lawson Health Research Institute in London, Ont. His specialization is SPECT (single photon emission computed tomography) as it relates to heart imaging.

Trevor Stocki – is a health physicist at the Radiation Protection Bureau, Health Canada. He is involved in environmental monitoring of radioactivity in support of the Comprehensive Nuclear Test Ban Treaty.

After more than ten years, Giles Santyr bade farewell to OMPI and the Ottawa environs. Giles is continuing his research into functional MRI at the Robarts Research Institute (London, Ont).

Graduate Program

This academic year, Paul Johns gave our foundation course, *Medical Radiation Physics*, in the fall term to an enrollment of 8 new M.Sc. students (plus Special and Audit students). Eight students took the *Medical Physics Practicum* coordinated by Julia Wallace with modules offered by Ian Cameron, Brenda Clark, Joanna Cygler, Rob deKemp, Lee Gerig, C.B. Kwok, Malcolm McEwen, Balazs Nyiri, Carl Ross, Michael Thomas, Richard Wassenaar, Dave Wilkins, and Ruth Wilkins. In the winter term, *Physics of Medical Imaging* was taught to a class of 10 by new faculty member Tong Xu (coordinator), Ian Cameron, Rob deKemp, and Richard Wassenaar. Eleven students took *Medical Radiotherapy Physics* with David Rogers, and 4 students took *Radiobiology* with Ruth Wilkins (coordinator) and Cheng Ng. Thank you to all those who taught in our program, especially those from outside Carleton who made the time available to benefit our students.

Table 3 lists the graduate students in the program, and Table 4 the graduate theses (three M.Sc. plus three Ph.D.) completed in 2006-2007. In August 2006, Marzieh Nezamzadeh completed her Ph.D. and is now a post-doc in MRI at UCSF. Cliff Dugal completed his MSc at the start of September 2006. Cliff was the first graduate of Carleton's new Engineering Physics undergraduate program to go into medical physics. Randle Taylor completed his M.Sc. and is currently a research assistant in David Rogers' group, doing further work concerning Monte Carlo and brachytherapy. Ken Nkongchu completed his Ph.D. and will start a diagnostic physics residency at Henry Ford Health System in Detroit. In January 2007, Andrei Andrievski, who was Ruth Wilkins' first student, completed his MSc. Finally, in the spring Essi Ghasroddashti completed his Ph.D. and is currently a therapy physics resident at the Regional Cancer Centre in London Ontario. Congratulations to all of our graduates!

Seminars

The monthly OMPI seminars (Table 5) continue to be well attended: thank you to all speakers and attendees. Once again we followed the annual tradition of a fall soccer game after the season's first seminar and a BBQ after the final seminar. Regarding the latter, the unpredictable May weather was kind to us and the only ice was in the drinks! Thank you to all event organizers: the events were a great success and we hope to build on these in the coming season.

Table 6 lists the 2006-2007 medical physics component of the regular weekly seminar series of the Carleton University Department of Physics.

OMPI Website (www.physics.carleton.ca/ompi)

The OMPI Secretary maintains a website with detailed information as follows:

- Members – profile of research activities, publications, and funding of each member
  – directory of Phone, Fax, and Email contact information
- Students – current MSc and PhD student project areas and supervisors
  – past graduates and their current positions
- Seminars – abstracts and dates of current and past monthly OMPI seminars
- News – current OMPI events
- Annual Reports – current and past Annual Reports
- Exec & Rules – current OMPI Executive, and rules of operation of the organization
- Societies – relevant scientific and professional societies and local contact names
- Ottawa Links – web links to host institutions and other relevant organizations
- Courses – graduate courses and requirements for students in medical physics
- Information – for prospective graduate students
- Contact Info – email addresses to contact OMPI

OMPI News and Events

Brenda Clark (TOHRCC) stepped down in January 2007 as Chair of CAMPEP after six years of service. CAMPEP (the Commission on Accreditation of Medical Physics Educational Programs) accredits medical physics graduate programs and residency programs in North America, which is becoming increasingly important in the registration of clinical medical physicists.

Joanna Cygler has been elected as Fellow of the American Association of Physicists in Medicine. This prestigious award recognises “distinguished contributions to medical physics”. Joanna’s election was formally announced at the AAPM Annual Meeting in Minneapolis in July 2007. At the same time three other illustrious scientists and former members of OMPI also received Fellowships: Ken Shortt (currently Director of Dosimetry Services at the IAEA); Bruce Faddegon (OMPI member and alumnus of the Carleton medical physics program, now Associate Professor at the University of California San Francisco), and Jan Seuntjens (Associate Professor at McGill University).

David Wilkins, from the Cancer Centre, is Vice President of the Canadian College of Physicists in Medicine (CCPM), which certifies clinical medical physicists in Canada. This essential activity provides the necessary mechanism for medical institutions to ensure that a high standard of medical physics services are available for patient care.

Our students also continue to win awards. Congratulations to Dan La Russa and David Rogers for winning the AAPM’s Farrington Daniels Award for best dosimetry paper of 2006 – “An EGSnrc investigation of the P_{TP} correction factor for ion chambers in kilovoltage x rays”, *Med. Phys.* **33**, 4590-4599 (2006).

OMPI Executive

I would like to thank the following for serving on the Executive in 2006-2007: David Rogers (Academic Officer), Rob De Kemp (Past-Director), and Ruth Wilkins (Secretary). Ruth, in particular, should be singled out for excellence in record keeping and maintaining the OMPI website. Thanks to Brian King for representing the students, and to our observers – Brenda Clark (TOHRCC) and Richard Wassenaar (The Ottawa Hospital). Ian Cameron of The Ottawa Hospital officially stepped down from the Executive this year after many years of service. I'd like to take this opportunity to thank Ian for the significant contributions he has made to the work of OMPI over the last decade. Fortunately this is only an end to Executive duties – Ian will continue to be actively involved in the graduate program as both a supervisor and lecturer.

Conclusion

In closing, thank you to all OMPI members and graduate students for your support this past year. OMPI continues to be the premiere forum for medical physicists in Ottawa and the growing membership bodes well for the future. The aim over the next few years is to continue to build relationships and further raise the profile of OMPI. One major activity for OMPI that is on the horizon is the annual meeting of the Canadian Organization of Medical Physicists (COMP), which will be held in Ottawa in 2010. It will be a great opportunity for OMPI to show to the rest of Canada the strength of medical physics in the nation's capital.

Table 1. OMPI Members, 2006-2007.

For details see *www.physics.carleton.ca/ompi* and select Membership Profile.
For a summary listing of contact information, select Directories.

	Member	Institution and Unit	Specialization within Medical Physics
1	Ian Cameron	Diagnostic Imaging The Ottawa Hospital	MRI
2	Brenda Clark	Department of Medical Physics The Ottawa Hospital Regional Cancer Centre	Radiotherapy
3	Joanna Cygler	Department of Medical Physics The Ottawa Hospital Regional Cancer Centre	Radiotherapy
4	Robert deKemp	Cardiac P.E.T. Centre University of Ottawa Heart Institute	PET
5	Madhu Dixit[§]	Department of Physics Carleton University	Detectors for ionizing radiation
6	Elagu Elaguppillai	Pharma Research Canada Inc.	Radiation protection
7	Lee Gerig	Department of Medical Physics The Ottawa Hospital Regional Cancer Centre	Radiotherapy
8	Clive Greenstock	Retired from AECL Chalk River Laboratories	Radiation biophysics
9	Elizabeth Henderson	Department of Medical Physics The Ottawa Hospital Regional Cancer Centre	Radiotherapy
10	Bog Jarosz	Department of Physics Carleton University	Ultrasound thermal therapy

11	Paul Johns	Department of Physics Carleton University	X-ray imaging
12	Iwan Kawrakow	Ionizing Radiation Standards Inst. National Measurement Standards, NRC	Radiotherapy and radiation dosimetry
13	Miller MacPherson	Department of Medical Physics The Ottawa Hospital Regional Cancer Centre	Radiotherapy
14	Malcolm McEwen	Ionizing Radiation Standards Inst. National Measurement Standards, NRC	Radiation dosimetry
15	Cheng Ng	Ottawa Hospital Research Institute	Radiobiology and hyperthermia
16	G. Peter Raaphorst	Retired from The Ottawa Hospital Regional Cancer Centre; Consultant in medical physics.	Radiobiology and hyperthermia
17	Richard Richardson	Radiation Biology & Health Physics Chalk River Laboratories, AECL	Radiation physics and radiation protection
18	Dave Rogers	Department of Physics Carleton University	Radiotherapy and radiation dosimetry
19	Carl Ross	Ionizing Radiation Standards Inst. National Measurement Standards, NRC	Radiation dosimetry
20	Giles Santyr	Robarts Institute, University of Western Ontario	MRI
21	Ken Shortt	Ionizing Radiation Standards Inst. National Measurement Standards, NRC Currently on leave to IAEA, Vienna.	Radiation dosimetry
22	Trevor Stocki	Radiation Protection Bureau, Health Canada	Health Physics
23	Jason (Jiansheng) Sun	Therapy Systems, Nucletron Canada	Radiation treatment planning
24	Janos Szanto	Department of Medical Physics The Ottawa Hospital Regional Cancer Centre	Radiotherapy
25	Tony Waker	School of Energy Systems & Nuclear Science University of the Ontario Inst. of Technology	Radiation physics and radiation protection
26	Julia Wallace	Sessional Lecturer Department of Physics, Carleton University	MRI
27	Richard Wassenaar	Division of Nuclear Medicine The Ottawa Hospital	Nuclear medicine imaging
28	Glenn Wells	University of Ottawa Heart Institute	Nuclear cardiology
29	David Wilkins	Department of Medical Physics The Ottawa Hospital Regional Cancer Centre	Radiotherapy
30	Ruth Wilkins	Consumer and Clinical Radiation Protection Bureau, Health Canada	Radiobiology
31	Tong Xu	Department of Physics Carleton University	Motion tracking using PET

[§]Associate Member

Table 2. OMPI Executive, 2006-2007.

Position	Member
Director[§]	Malcolm McEwen
Past-Director[§]	Rob deKemp
Academic Officer[§]	Dave Rogers
Secretary[§]	Ruth Wilkins
Student Representative[†]	Brian King
Seminar Organizer	Miller MacPherson
Observer – TOHRCC	Brenda Clark
Observer – The Ottawa Hospital	Ian Cameron
Observer – The Ottawa Hospital	Richard Wassenaar
Observer – Carleton Physics	Paul Johns

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

Table 3. Graduate Students in Medical Physics, 2006-2007.

For details see *www.physics.carleton.ca/ompi* and select Students. A list of Past Graduates is also available.

	Student	Degree	Supervisor	Project Area
1	Elsayed Ali	M.Sc.	Dave Rogers	Monte Carlo modelling of x-ray tubes
2	Andrei Andrievski	M.Sc. ✓	Ruth Wilkins	Novel biological dosimeters
3	Lindsay Beaton	M.Sc.	Ruth Wilkins	Novel biological dosimeters
4	Amanda Cherpak	M.Sc.	Joanna Cygler	Radiation dosimetry applications of MOSFETs
5	Daljit Dhaliwal	M.Sc.	Cheng Ng	Biophysics
6	Cliff Dugal	M.Sc. ✓	David Wilkins	Radiation protection and radiotherapy facility design
7	Tyler Dumouchel	M.Sc.	Rob deKemp	Small-animal PET
8	Claire Foottit	Ph.D.	Ian Cameron	Bolus-tracking MR perfusion imaging
9	Maria Lourdes Garcia-Fernández	Ph.D.	G. Peter Raaphorst & David Wilkins	Radiobiological model development and verification
10	Esmaeel Ghasroddashti	Ph.D. ✓	Lee Gerig	Gated radiation therapy
11	Brian King	Ph.D.	Paul Johns	X-ray scatter imaging: measurement of cross sections
12	Michel Lalonde	M.Sc.	Richard Wassenaar	Nuclear medicine
13	Marc Lamoureux	M.Sc.	Rob deKemp	PET
14	Dan La Russa	Ph.D.	Dave Rogers	Accuracy of Spencer-Attix cavity theory
15	Ernesto Mainegra-Hing	Ph.D.	Iwan Kawrakow	MC corrections for x-ray standards
16	José Martinez-Ortega	Ph.D.	Bog Jarosz	Ultrasound interstitial thermal therapy for brain tumours
17	Andrew McDonald	M.Sc.	Carl Ross	Linac benchmarking of Monte Carlo simulation models
18	Tara Murphy	M.Sc.	Joanna Cygler	Experimental verification of radiotherapy
19	Kenji Myint	Ph.D.	Lee Gerig	Therapy planning effect on TCP, NTCP for lung lesions

20	Marzieh Nezamzadeh	Ph.D. ✓	Ian Cameron	MR diffusion imaging
21	Ken Nkongchu	Ph.D. ✓	Giles Santyr	Gel radiation dosimetry with MRI
22	Elena Olariu	Ph.D.	Ian Cameron	MR tractography of white matter
23	Jennifer Renaud	M.Sc.	Rob deKemp	PET
24	Mojgan Soleimani	M.Sc.	Tong Xu	Motion tracking using PET
25	Jared Strydhorst	M.Sc.	Brenda Clark	Tomotherapy
26	Randle Taylor	M.Sc. ✓	Dave Rogers	Monte Carlo brachytherapy treatment planning
27	Sorina Truica	Ph.D.	Ian Cameron	Non-contrast methods in perfusion MRI
28	Lilie Wang	Ph.D.	Dave Rogers	Radiation dosimetry correction factors via Monte Carlo

✓ Degree completed between 2006 July 1 and 2007 June 30; see Table 4

Table 4. Theses Completed, 2006-2007.

Student	Degree	Supervisor	Thesis Title and Date of Defence
Marzieh Nezamzadeh	Ph.D.	Ian Cameron	*Rician Noise Corrected Multi-Component Analysis of the MR Diffusion Signal Decay for Human Brain In Vivo* 2006 August 23 External Examiner: Gilles Beaudoin, CHUM/Univ. de Montréal
Cliff Dugal	M.Sc.	David Wilkins	*Application of Monte Carlo to Linac Bunker Shielding Design* 2006 September 5
Randle Taylor	M.Sc.	David Rogers	*Monte Carlo Calculations for Brachytherapy* 2006 September 7, with distinction.
Ken Nkongchu	Ph.D.	Giles Santyr	*Magnetic Resonance Imaging Approaches to Gel Dosmetry for Validation of Conformal Radiotherapy Treatment Plans* 2006 September 11 External Examiner: Martin LePage, Université de Sherbrooke
Andrei Andrievski	M.Sc.	Ruth Wilkins	*Characterizing of γH2AX Response of Human Lymphocytes to Ionizing Radiation* 2007 January 3
Esmaeel Ghasroddashti	Ph.D.	Lee Gerig	*Predicting Respiratory Induced Tumour Motion using External Surrogates* 2007 May 16 External Examiner: Katharina Sixel, R.S. McLaughlin Durham Regional Cancer Centre

Table 5. OMPI Seminars, 2006-2007.

Seminars are held 3:30 - 5:00 p.m. on the second or third Thursday of the month. The first speaker is a graduate student, and the second speaker is an OMPI member. For details see *www.physics.carleton.ca/ompi* and select Seminars.

Date and Location	Speakers and Titles
2006 September 21 Carleton University	Esmaeel Ghasroddashti, *Predicting Tumour Motion* Tong Xu, *Radiation Therapy and Intervention with the Aid of Positron Emission based Real-Time Tracking*
2006 October 26 Health Canada, RPB	Kenji Myint, *Treatment Dose Errors Resulting from the Use of Diagnostic CT Images for Treatment Planning* Ruth Wilkins, *A Novel Method for Biological Dosimetry for Ionizing Radiation*
2006 November 23 National Research Council – INMS	Elsayed Ali, *Efficiency Improvements of X-Ray Simulations in EGSnrc User-Codes using Bremsstrahlung Cross Section Enhancement (BCSE)* Balazs Nyiri, *A Continuum Formulation of Tumour Control Probability*

2007 January 25 Ottawa Hospital - Civic	Ernesto Mainegra-Hing, *X-Ray Modelling with EGSnrc for Medium Energy Beam Qualities* Glenn Wells, *Correcting for Breathing in Cardiac PET/CT*
2007 February 15 Carleton University	Lindsay Beaton, *Monte Carlo Simulation of a Semi-Infinite Cloud to Find the Air Kerma of Ar-41 and Xe-133* Trevor Stocki, *Atmospheric Radionuclide Monitoring at Health Canada for the Comprehensive Nuclear-Test-Ban Treaty and the Well Being of Canadians*
2007 March 22 Ottawa Heart Institute	Maria Lourdes Garcia-Fernández, *Total Marrow Irradiation using Helical Tomotherapy* Bog Jarosz, *Dose Evaluation in Low Dose Rate Thermal Therapy – Is it Feasible?*
2007 May 24 National Research Council – INMS	Amanda Cherpak, *MOSFET Detectors in Quality Assurance of Tomotherapy Treatments* David Rogers, *Fast Monte Carlo Dose Calculations for Brachytherapy with Seed, HDR or X-Ray Sources*

Table 6. Carleton University Department of Physics Seminars in Medical Physics, 2006-2007.

Listed are departmental seminars on medical physics topics. Also listed are the medical physics graduate student speakers in the Fall and Spring OCIP Student Seminars. See *www.physics.carleton.ca/seminars* for a complete list.

Date	Speaker, Institution, and Title
2006 September 11	Martin LePage, Médecine Nucl. et Radiobiologie, Université de Sherbrooke *MRI of Cancer in Humans and Small Animal Models*
2006 December 8 OCIP Fall Graduate Student Seminars	Elsayed Ali, Carleton University *Efficiency Improvements of X-Ray Simulations in EGSnrc User-Codes using Bremsstrahlung Cross Section Enhancement (BCSE)* Tyler Dumouchel, Carleton University *Initial Performance Evaluation Results with the LabPET Animal Scanner* Kenji Myint, Carleton University *Treatment Dose Errors Resulting from the Use of Diagnostic CT Images for Treatment Planning*
2006 December 12	Luc Beaulieu, CHUQ/Université Laval, Québec *Translating Physics Knowledge into Useful Concepts for Radiation Therapy*
2006 December 15 OCIP Christmas Symp.	Tong Xu, Carleton University *Dual-Energy X-Ray Imaging and Its Medical Applications*
2007 February 27	Richard Wassenaar, Division of Nuclear Medicine, The Ottawa Hospital *Quantifying Cardiac Contractions using Single Photon Emission Tomography*
2007 March 6 (OCIP Seminar)	Andrew Ridsdale, Ottawa Health Research Institute *The Importance of Treating Living Cells as States of Matter and Some Suggestions on How to Proceed*
2007 March 20	L. John Schreiner, Cancer Centre of Southeastern Ontario, Kingston Ontario *Is there a Role for Simple Devices in Modern Radiation Therapy ? Co-60 and Optical CT.*
2007 April 10	Glenn Wells, University of Ottawa Heart Institute *Integrating CT into Nuclear Medicine Imaging*
2007 May 28 and June 4 OCIP Spring Graduate Student Seminars	Amanda Cherpak, Carleton University *MOSFET Detectors in Quality Assurance of Tomotherapy Treatments* Andrew McDonald, Carleton University *Measured Electron Scattering Distributions in the MeV Range and Comparison to Calculations*
2007 June 25	Rolf Clackdoyle, Laboratoire Hubert Curien, Université Jean Monnet, St. Etienne, France *Classical Computed Tomography: What's New ?*