

# Ottawa Medical Physics Institute ( OMPI )

*An Organized Research Unit of the Department of Physics,  
Carleton University, Ottawa, Canada*

[www.physics.carleton.ca/ompi](http://www.physics.carleton.ca/ompi)

Annual Report # 15  
1 July 2002 – 30 June 2003

*Submitted by Robert deKemp, PhD, PPhys, OMPI Director.*

## **Introduction**

Medical physicists are applied scientists who use the tools of physics to improve health care - in cancer therapy, in the related area of medical biophysics, and in medical imaging. Medical physicists have developed revolutionary technologies such as photon and electron cancer treatment machines, and CT, PET and MR imagers. It is difficult to imagine modern medicine without these technologies: medical physics has brought large improvements to patient care.

The Ottawa Medical Physics Institute (OMPI), founded in 1989, is an organized research unit of the Department of Physics of Carleton University in Canada's national capital, Ottawa. It is a very active network of approximately 30 medical physicists in the Ottawa region. The Ottawa medical physics community has one of the most diverse spectra of research and service activities in Canada. Our members are located at Atomic Energy of Canada Limited (AECL) Chalk River, Health Canada, the National Research Council of Canada (NRC), the University of Ottawa Heart Institute, the Ottawa Hospital, the Ottawa Regional Cancer Centre, 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 2002-2003 academic year, and is also available on the OMPI web site ([www.physics.carleton.ca/ompi](http://www.physics.carleton.ca/ompi)).

### **Funding and Publications**

In 2002-2003 OMPI members had over \$1.1M directly available in research funds from the Natural Sciences and 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 U.S. National Institutes of Health (NIH), the Canada Foundation for Innovation (CFI), the Chemical, Biological, Radiological and Nuclear (CBRN) Research Technology Initiative (CRTI), and others. Furthermore, OMPI scientists participated in research consortia such as the Imaging Network Ontario (funded by the Ontario Research and Development Challenge Fund (ORDCF) and private industry partners), with total budgets of approximately \$60M. These research funds are administered through Carleton University, the University of Ottawa, and the individual institutions of our members.

In the calendar year 2002, OMPI members published over 40 peer-reviewed scientific papers, proceedings, and technical reports on their research here in the national capital region.

### **Membership**

Table 1 summarizes our membership, which now numbers 29. A list of current members and their research profiles is maintained on the web site. Table 2 lists the Executive. In 2002-2003 OMPI welcomed two new members:

**Malcolm McEwen** – is a scientist working in Ionising Radiation Standards at the NRC Institute for National Measurement Standards. Before coming to the NRC in 2002, Malcolm was with the National Physical Laboratory in the UK for 13 years, where he helped to establish a co-ordinated audit scheme for UK radiotherapy dosimetry. Malcolm has volunteered to be the new OMPI seminar organizer next year.

**Miller MacPherson** – is a medical physicist at the Ottawa Regional Cancer Centre. Miller is a graduate of the Carleton medical physics program (PhD '98), and Fellow of the CCPM. His research includes development of IMRT methods at ORCC and gated radiotherapy.

In Feb 2003, one of our recent OMPI members Akhilesh Trivedi died suddenly and tragically of a heart attack. He was working at Health Canada investigating non-cancer health risks associated with radiation therapy.

### **Graduate Program**

This academic year four graduate half-courses in medical physics were offered, two in each term. In the fall, Medical Radiation Physics was taught by Giles Santyr, and the Medical Physics Practicum was coordinated by Giles Santyr, with modules supervised by Ian Cameron, Lee Gerig, Gabe Lam, and Peter Raaphorst. In the winter term, Radiobiology was taught by Peter Raaphorst, and lectures in the Physics of Medical Imaging were given by Giles Santyr (course coordinator), Rob deKemp, Paul Johns, and Barry McKee. Special thanks to the off-campus instructors for finding the time to teach in our program. Your experience and effort continue to make our program a success.

Table 3 lists the graduate students in the program, and Table 4 the graduate theses (two M.Sc.) which were completed in 2002-2003. In September 2002 Salomeh Jelveh defended her M.Sc. She is now working in the computer software industry for health care applications. Elena Olariu defended her M.Sc. in April 2003, with distinction awarded on the defence. Congratulations also on birth of their first child during her Master's studies (March 2002). Elena has entered our PhD program and is continuing to do research in MRI at the Ottawa Hospital under the supervision of Ian Cameron.

Congratulations to those students who won or maintained external awards this year: Stephen White (NSERC PGS A), Andrew Wind (NSERC PGS A), Richard Wassenaar (OGS), and Carey Larsson (OGSST). Furthermore, Marco Carlone has just been awarded a CCPE (Canadian Council of Professional Engineers) - Meloche Monnex Scholarship. Only two of these national scholarships are awarded annually. The scholarships are to assist engineers returning to university for further study or research in a field other than engineering.

### **Seminars**

The monthly OMPI seminars (Table 5) continue to be well attended. E-mail announcements (ascii text) are sent to all those on our seminar list. A formatted announcement with abstracts, suitable for printing, is available on the web site ([www.physics.carleton.ca/ompi](http://www.physics.carleton.ca/ompi)). Thank you to all speakers and attendees. We followed last year's pattern of having a fall soccer game and a winter broomball game after the seminar. Thank you to all event organizers - the events were a success and we intend to continue this tradition in future years.

Table 6 lists the 2002-2003 medical physics component of the regular weekly seminar series of the Carleton University Department of Physics. Several other Ottawa institutions also host invited speakers in medical physics such as the NRC Ionizing Radiation Standards group, the Ottawa Hospital Oncology Grand Rounds and the Ottawa Hospital City Wide Nuclear Medicine Rounds.

### **OMPI Web Site ([www.physics.carleton.ca/ompi](http://www.physics.carleton.ca/ompi))**

Since its inception in 1989 through to 2000, the OMPI produced an annual Newsletter, in part to serve as an annual report to the Dean of Graduate Studies on our activities. The information in these newsletters contained OMPI member profiles, research interests, and publications, as well as current graduate student projects, OMPI seminars, and general information about the graduate program in Medical Physics. Commencing in 2001, this detailed information has been maintained on the web site, and is summarized in the Annual Report each academic year.

The web site is maintained by the OMPI Secretary. The current information on this site has been used to produce this Annual Report.

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

### **OMPI News**

Daryoush Sheikh-Bagheri and Dave Rogers won the prestigious 2003 Farrington Daniels Award from the AAPM for the best paper in radiation dosimetry published in 2002 entitled “*Sensitivity of megavoltage photon beam Monte Carlo simulations to electron beam parameters*” (Medical Physics **29**,391-402(2002)).

Recruitment of the Tier 1 Canada Research Chair (CRC) in Medical Physics is almost complete. The search committee has made their recommendation, and the nomination was submitted to the Canada Research Chairs secretariat in the spring 2003. The official announcement is expected in the fall 2003.

Two OMPI members completed their membership certification with the Canadian College of Physicists in Medicine: Ian Cameron, PhD, MCCPM and Giles Santyr, PhD, MCCPM.

### **OMPI Executive**

I would like to thank the following for serving on the Executive in 2002-2003: Bog Jarosz and Paul Johns (Academic Officers), Ian Cameron (Past-Director), and Ruth Wilkins (Secretary) for keeping excellent minutes and maintaining the OMPI web site. Thanks to Kenji Myint for representing the students, and to Cheng Ng and Dave Rogers for representing their groups by attending as Observers. A special thanks also to David Wilkins for his ability and persistence in organization of the OMPI seminars for the last 4 years. Malcolm McEwen from the NRC has graciously volunteered to take over as seminar organizer next year.

### **Conclusion**

In closing, thank you to all OMPI members and graduate students for your support this past year. Our graduates are in high demand and we foresee that situation continuing. We work in one of the most interesting and relevant applications of science in our society - enjoy and be creative !

**Table 1. OMPI Members, 2002-2003.**

For details see [www.physics.carleton.ca/ompi](http://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 Ottawa Hospital	MRI
2	Robert Clarke	Department of Physics Carleton University (Professor Emeritus)	Ultrasound tissue ablation
3	Joanna Cygler	Department of Medical Physics Ottawa Regional Cancer Centre	Radiotherapy and radiobiology
4	George Daskalov	Ionizing Radiation Standards Inst. National Measurement Standards, NRC	Radiotherapy
5	Robert deKemp	Cardiac P.E.T. Centre University of Ottawa Heart Institute	PET
6	Madhu Dixit <sup>§</sup>	Department of Physics Carleton University	Detectors for ionizing radiation
7	Pavel Dvorak	Consumer and Clinical Radiation Protection Bureau, Health Canada	Radiation protection
8	V. Elaguppillai	Retired/Consultant	Radiation protection
9	Lee Gerig	Department of Medical Physics Ottawa Regional Cancer Centre	Radiotherapy
10	Clive Greenstock	Safety & Radiological Protection, Chalk River Laboratories, AECL	Radiation biophysics

11	Bog Jarosz	Department of Physics Carleton University	Ultrasound thermal therapy
12	Paul Johns	Department of Physics Carleton University	X-ray imaging
13	Iwan Kawrakow	Ionizing Radiation Standards Inst. National Measurement Standards, NRC	Radiotherapy and radiation dosimetry
14	Gabriel Lam	Department of Medical Physics Ottawa Regional Cancer Centre	Radiotherapy
15	Miller MacPherson	Department of Medical Physics Ottawa Regional Cancer Centre	Radiotherapy
16	Malcolm McEwen	Ionizing Radiation Standards Inst. National Measurement Standards, NRC	Radiation dosimetry
17	Barry McKee	Diagnostic Imaging Ottawa Hospital	Nuclear medicine imaging
18	Cheng Ng	Department of Medical Physics Ottawa Regional Cancer Centre	Radiobiology and hyperthermia
19	Peter Raaphorst	Department of Medical Physics Ottawa Regional Cancer Centre	Radiobiology and hyperthermia
20	Richard Richardson	Radiation Biology & Health Physics Chalk River Laboratories, AECL	Radiation physics and radiation protection
21	Dave Rogers	Ionizing Radiation Standards Inst. National Measurement Standards, NRC	Radiotherapy and radiation dosimetry
22	Giles Santyr	Department of Physics Carleton University	MRI
23	Ken Shortt	Ionizing Radiation Standards Inst. National Measurement Standards, NRC	Radiation dosimetry
24	Jason (Jiansheng) Sun	Therapy Systems, Nucletron Canada	Radiation treatment planning
25	Janos Szanto	Department of Medical Physics Ottawa Regional Cancer Centre	Radiotherapy
26	Akhilesh Trivedi	Radiation Protection Bureau Health Canada and AECL	Radiation protection
27	Tony Waker	Radiation Biology & Health Physics Chalk River Laboratories, AECL	Radiation physics and radiation protection
28	Julia Wallace	Carleton Magnetic Resonance Facility Department of Physics, Carleton University	MRI
29	David Wilkins	Department of Medical Physics Ottawa Regional Cancer Centre	Radiotherapy
30	Ruth Wilkins	Consumer and Clinical Radiation Protection Bureau, Health Canada	Radiobiology

<sup>§</sup>Associate Member

**Table 2. OMPI Executive, 2002-2003.**

Position	Physicist
Director <sup>§</sup>	Robert deKemp
Past-Director <sup>§</sup>	Ian Cameron
Academic Officer <sup>§</sup>	Bog Jarosz (to Feb 2003) Paul Johns (Feb 2003 to date)
Secretary <sup>§</sup>	Ruth Wilkins
Student Representative <sup>†</sup>	Kenji Myint
Seminar Organizer	David Wilkins
Observer ORCC	Cheng Ng
Observer NRC	Dave Rogers

<sup>§</sup>position elected by the members

<sup>†</sup>position elected by the medical physics graduate students

**Table 3. Graduate Students in Medical Physics, 2002-2003.**

For details see [www.physics.carleton.ca/ompi](http://www.physics.carleton.ca/ompi) and select Students. A list of Past Graduates is also available.

	Student	Degree	Supervisor	Project Area
1	Nishard Abdeen	M.Sc.*	Giles Santyr	Lung gas exchange kinetics via hyperpolarized Xe MRI
2	Lesley Buckley	Ph.D.	Dave Rogers	EGS radiation transport modelling
3	Marco Carlone	Ph.D.	Peter Raaphorst	Biophysics
4	Zhanrong Gao	Ph.D.	Lee Gerig	Geometric uncertainties in prostate radiotherapy
5	Esmaeel Ghasroddashti	Ph.D.	Lee Gerig	Gated radiation therapy
6	Mihai Gherase	Ph.D.	Giles Santyr	Contrast agents for hyperpolarized Xe MRI
7	Ziaul Hasan	M.Sc.	Paul Johns	Diffraction data for X-ray scatter imaging
8	Salomeh Jelveh	M.Sc. ✓	Bog Jarosz Robert Clarke	Ultrasound interstitial thermal therapy for brain tumours
9	Carey Larsson	Ph.D.	Robert deKemp	Rubidium-82 perfusion with 3-dimensional PET
10	José Martinez-Ortega	Ph.D.	Bog Jarosz	Ultrasound interstitial thermal therapy for brain tumours
11	Dana Mullins	M.Sc.	Cheng Ng	Effect of circadian rhythm on radiation therapy
12	Kenji Myint	Ph.D.	Lee Gerig	Radiotherapy process simulation
13	Marzieh Nezamzadeh	Ph.D.	Ian Cameron	MRI diffusion imaging
14	Gosia Niedbala	Ph.D.	Peter Raaphorst	Biophysics of radiation damage and repair
15	Mohammad Nisar	M.Sc.	Paul Johns	Collimation for x-ray scatter imaging
16	Ken Nkongchu	Ph.D.	Giles Santyr	Gel radiation dosimetry with MRI

17	Elena Olariu	M.Sc. ✓ Ph.D.	Ian Cameron Ian Cameron	MRI diffusion imaging MRI diffusion imaging
18	Juan Parra-Robles	Ph.D.	Giles Santyr	Low-field MRI system using hyperpolarized Xe
19	Sorina Truica	Ph.D.	Ian Cameron	Hyperpolarized Xe MRI of human lung
20	Richard Wassenaar	Ph.D.	Robert deKemp	Partial volume corrections in cardiac PET
21	Steven White	M.Sc.	Giles Santyr	Absolute lung volume via hyperpolarized Xe MRI
22	Andrew Wind	M.Sc.	Barry McKee	Pinhole SPECT imaging

\* Part-time

✓ Degree completed between 1 July 2002 and 30 June 2003; see Table 4

**Table 4. Theses Completed, 2002-2003.**

Student	Degree	Supervisor	Thesis Title and Date of Defence
Salomeh Jelveh	M.Sc.	Bog Jarosz Robert Clarke	<i>Interstitial Hyperthermia of Brain Tumours</i> 16 September 2002
Elena Olariu	M.Sc.	Ian Cameron	<i>Monte Carlo Studies of the Magnetic Resonance Diffusion Decay</i> 28 April 2003 (passed with distinction)

**Table 5. OMPI Seminars, 2002-2003.**

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](http://www.physics.carleton.ca/ompi) and select Seminars.

Date and Location	Speakers and Titles
26 September 2002 Carleton University	Marzieh Nezamzadeh, <i>Compartmental Diffusion in Human White Matter and Analysis by NNLS</i> Robert Clarke, <i>High Intensity Focused Ultrasound for the Treatment of Tumors</i>
24 October 2002 Ottawa Heart Institute	José Martinez, <i>Can The Blood Vessels in the Brain Change the 3D-Temperature Distribution Generated by Interstitial Waveguide Ultrasound Applicators?</i> Janos Szanto, <i>Image Guided Radiotherapy</i>
21 November 2002 National Research Council, INMS	No student presentation Joanna Cygler, <i>Translational Research in Ottawa: Taking Monte Carlo Calculations from the Lab to a Cancer Clinic Near You</i>
12 December 2002 Ottawa Hospital, Riverside Campus	Marco Carlone, <i>Limits of the Linear Quadratic Model in Radiotherapy</i> Cheng Ng, <i>Discovering X-Radiation Response Genes: Goodbye Radiobiology, Hello Radiogenomics?</i>
16 January 2003 Health Canada, Radiation Protection Bureau	Mihai Gherase, <i>An Echo-By-Echo Study of the Exchange of Hyperpolarized Xe in a PFOB Emulsion</i> Paul Johns, <i>Radiologic Image Quality, Dose, Quality Assurance, and the Physicist</i>
13 February 2003 Carleton University	Juan Parra-Robles, <i>Passive Shimming of the Fringe Field of a Superconductive Magnet for Laser-Polarized Noble Gas MRI</i> Lee Gerig, <i>Radiation Therapy for Breast Cancer</i>

20 March 2003 ORCC, General Campus	Ziaul Hasan, <i>Measurement of X-Ray Differential Scattering Cross-Section over a Wide Range of Momentum Transfer Parameter</i> Malcolm McEwen, <i>The Role of the Standards Laboratory in Radiotherapy Dosimetry - A UK Perspective</i>
8 May 2003 Carleton University	Carey Larsson, <i>Quantification of Myocardial Blood Flow with Rubidium-82 and 3-D Positron Emission Tomography</i> Miller MacPherson, <i>Accounting for Respiratory Motion During Radiation Therapy</i>

**Table 6. Department of Physics Seminars in Medical Physics, 2002-2003.**

Seminars by invited speakers are usually held 3:30 - 5:00 p.m. on a Monday. Also shown here are the medical physics graduate student speakers in the Fall and Spring OCIP Student Seminars. For a complete list of current and past seminars, see [www.physics.carleton.ca/seminars](http://www.physics.carleton.ca/seminars).

Date	Speaker, Institution, and Title
28 October 2002	Andy Adler, University of Ottawa, School of Information Technology and Engineering <i>Electrical Impedance Tomography - Image Reconstruction and Applications</i>
28 November 2002	Dave Rogers, NRC, Institute for National Measurement Standards <i>Radiation Transport by Monte Carlo: From High Energy Physics to the Clinic</i>
3 December 2002 OCIP Fall Graduate Student Seminars	Elena Olariu, Carleton University, <i>Monte Carlo Studies of the Magnetic Resonance Diffusion Decay</i>
23 January 2003	John Schreiner, Kingston Regional Cancer Centre <i>Notes from a Small Clinic: Conformal Radiation Therapy Research in Co-60 Tomotherapy and Gel Dosimetry</i>
10 February 2003	Garry Tarr, Carleton University, Dept of Electronics <i>RADFETs and Radon: Detecting Ionizing Radiation Using Commercial CMOS Technology</i>
24 February 2003	Ian Thomson, Thomson & Nielsen Electronics Ltd. <i>Principles &amp; Applications of MOSFET Radiation Sensors in Medicine &amp; Space</i>
24 March 2003	Alain Gauvin, Centre Hospitalier de l'Université de Montréal (CHUM), <i>Implementation of PACS in a Large Teaching Hospital</i>
21 May 2003 OCIP Spring Graduate Student Seminars	Ziaul Hasan, Carleton University <i>Measurement of X-Ray Differential Scattering Cross Section over a Wide Range of Momentum Transfer Parameter</i> Dana Mullins, Carleton University <i>Chronomodulation of Topotecan and X-Radiation Therapy</i>