

Ottawa Medical Physics Institute (OMPI)

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

www.physics.carleton.ca/ompi

Annual Report # 14
1 July 2001 – 30 June 2002

Submitted by Robert deKemp, PhD, 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 MDS Nordion, 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 2001-2002 academic year, and is also available on the OMPI web site (www.physics.carleton.ca/ompi).

Funding and Publications

In 2001-2002 OMPI members had over \$3.8M 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), 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 over \$58M. These funds were administered through Carleton University, the University of Ottawa, and the individual institutions of our members.

In the calendar year 2001, OMPI members published over 37 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 28. A list of current members and their research profiles are maintained on the web site. Table 2 lists the Executive. In 2001-2002 OMPI welcomed one new member:

Akhilesh Trivedi – is a Research Scientist with Atomic Energy of Canada Limited with interests in radiological health, radiobiology, tritium monitoring and dosimetry; bioassay method developments; retrospective dosimetry, environmental radiation protection, and in the biochemistry and biophysics of biomembranes. He is currently working in the Radiation Protection Bureau at Health Canada in the area of *Radiation and Non-cancer Risk*, investigating the risks of atherosclerotic heart disease following radiation therapy.

Graduate Program

Last academic year we had a reduced offering of medical physics graduate courses. There were two courses offered: (1) 75.523 Medical Radiation Physics, taught by Paul Johns; and (2) 75.528 Radiation Protection coordinated by Elagu Elaguppillai, and taught by Elagu Elaguppillai, Clive Greenstock, and Tony Waker. These three OMPI members deserve a warm thank you for delivering this course. None live in Ottawa, and had to make long trips to give their lectures at Carleton. To simplify the logistics, the three-hour lectures each week were given in a single evening.

Table 3 lists the current graduate students in the program and Table 4 the graduate theses completed in 2001-2002 (5 M.Sc.). In the summer of 2001 Nina Kalach, Zhanrong Gao and Ken Nkongchu defended their M.Sc. Nina started working at the BC Cancer Agency, even prior to defending her thesis. Zhanrong and Ken are continuing in our Ph.D. program. Matthew Wismayer defended his M.Sc. in the fall of 2001. Carey Feagan completed her M.Sc. in December 2001 and is also continuing in our Ph.D. program. We are very proud that they have found homes in their respective research areas.

It is important to notice that in spite of record number of graduating students in the previous academic year, the overall number in 2001-2002 remained steady at approximately 20. Previously, many M.Sc. graduates decided to leave the program and start their professional careers, but this trend has changed in 2001-2002. Table 3 shows that the vast majority of graduate students in medical physics are now doctoral students, many having continued after graduating with Carleton's M.Sc. There are also several students who joined our Ph.D. studies from other programs.

And finally, two students deserve special congratulations; Richard Wassenaar and Marzieh Nezamzadeh, who were initially accepted into our M.Sc. program. Having made very impressive progress in their research and in their graduate courses, they applied to be fast-tracked to the Ph.D. level, and became the first students in our program to transfer directly to doctoral studies.

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). 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 2001-2002 medical physics seminars, which were given in the regular weekly 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)

Since its inception in 1989, OMPI has 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. Since 2001, this detailed information has been maintained on the web site, and is summarized in the Annual Report for 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
- Students – current MSc and PhD student project areas and supervisors
 - past graduates and their current positions
 - information for prospective graduate students
- Courses – graduate courses and requirements for students in medical physics
- Seminars – abstracts and dates of current and past OMPI seminars
- Reports – current and past Annual Reports
- News – current OMPI events
- Directories – contact information for members and students, in summary form
- Societies – relevant scientific and professional societies and local contact names
- Ottawa Links – web links to host institutions and other relevant organizations.

New Facilities

A new clinical therapy accelerator was installed at the NRC Ionizing Radiation Standards laboratory. Acquisition of this unit will be a real boost for medical physics research in Canada, and many programs will benefit from access to this unique resource. Cancer therapy researchers will be able to use a clinical machine which is not in routine clinical use, making this a close to unique facility.

The PET Cyclotron and Radiochemistry Laboratory was officially opened in June 2002 at the University of Ottawa Heart Institute. This facility will now be able to produce the short-lived PET tracers used for molecular imaging of blood flow and metabolism with the PET scanner at the Heart Institute.

Canada Research Chair (Tier 1) in Medical Physics

In March 2001, a letter was written to Peter Watson, Dean of the Faculty of Science requesting approval to begin the recruitment process for the Tier 1 CRC position allocated to Medical Physics. In early April, the Dean authorized the start of the hiring processes for this position, which is targeted to recruit a strong researcher in the area of cancer therapy physics. With the support of the Physics Department Chair John Armitage, a search committee was formed consisting of the incoming Department Chair Pat Kalyniak, Giles Santyr, Bog Jarosz, Gerald Oakham, Peter Raaphorst (ORCC) and Dave Rogers (NRC). The advertisement was drafted and approved by this committee and submitted in June for publication in the July issue of the Canadian Medical Physics Newsletter *Interactions*. The goal is to have the successful candidate appointed by July 2003.

OMPI Executive

I would like to thank the following for serving on the Executive in 2001-2002: Paul Johns and Bog Jarosz (Academic Officers) and Ian Cameron (Past-Director). Thanks also to David Wilkins for his ability and persistence in organization of the seminars, and to Ruth Wilkins (Secretary) for keeping excellent minutes and maintaining the OMPI web site, to Kenji Myint for representing the students, and to Cheng Ng and Dave Rogers for representing their groups by attending as Observers.

Special thanks go to Paul Johns for serving as OMPI Director from 1996-2001, and earning a well-deserved sabbatical this calendar year. Paul remains a strong advocate, always promoting OMPI interests and awareness. The development of the OMPI web site under his leadership, has made our program information widely available, and has made the production of this Annual Report a much more efficient process.

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, 2001-2002.

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 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 ^s	Department of Physics Carleton University	Detectors for ionizing radiation
7	Pavel Dvorak	Radiation Protection Bureau Health Canada	Radiation protection
8	V. Elagupillai	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

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

[§]Associate Member

Table 2. OMPI Executive, 2001-2002.

Position	Physicist
Director [§]	Robert deKemp
Past-Director [§]	Ian Cameron
Academic Officer [§]	Paul Johns (July-Dec 2001), Bog Jarosz (Jan-July 2002)
Secretary [§]	Ruth Wilkins
Student Representative [†]	Kenji Myint
Seminar Organizer	David Wilkins
Observer ORCC	Cheng Ng
Observer NRC	Dave Rogers

[§]position elected by the members

[†]position elected by the medical physics graduate students

Table 3. Graduate Students in Medical Physics, 2001-2002.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	Lesley Buckley	Ph.D.	Dave Rogers	EGS radiation transport modelling
2	Marco Carlone	Ph.D.	Peter Raaphorst	Biophysics
3	Carey Feagan	M.Sc. ✓ Ph.D.	Cheng Ng Robert deKemp	Role of p21 in thermal radiosensitization Rubidium-82 perfusion with 3D PET
4	Zhanrong Gao	M.Sc. ✓ Ph.D.	Lee Gerig Lee Gerig	Mathematical tumour growth model for radiotherapy Radiotherapy process simulation
5	Esmael 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 thermal therapy for brain tumours
9	Nina Kalach	M.Sc. ✓	Dave Rogers	Radiotherapy beam quality specifiers
10	Jose Martinez	Ph.D.	Bog Jarosz	Ultrasound interstitial thermal therapy for brain tumours
11	Dana Mullins	M.Sc.	Cheng Ng	Biophysics
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	Ken Nkongchu	M.Sc. ✓ Ph.D.	Ken Shortt & Giles Santyr	Radiation dosimetry using Fricke hydrogels and MRI Contrast agents for breast MRI
16	Elena Olariu	M.Sc.	Ian Cameron	MRI diffusion imaging
17	Juan Parra-Robles	Ph.D.	Giles Santyr	Low-field MRI system using hyperpolarized Xe
18	Razvan Simionescu	Ph.D.	Giles Santyr	Lung MRI
19	Flavie Tchoko	M.Sc.	Ian Cameron	MRI diffusion imaging
20	Richard Wassenaar	Ph.D.	Robert deKemp	Partial volume corrections in cardiac PET
21	Matthew Wismayer	M.Sc. ✓	Paul Johns	Diffraction data for x-ray scatter imaging

✓ Degree completed between 1 July 2001 and 30 June 2002; see Table 4

Table 4. Theses Completed, 2001-2002.

Student	Degree	Supervisor	Thesis Title and Date of Defence
Carey Feagan	M.Sc.	Cheng Ng	<i>A Study of the Role of p21/WAF1/CP1 in Thermal Radiosensitization</i> 13 December 2001 (passed with distinction)
Zhanrong Gao	M.Sc.	Lee Gerig	<i>A Three-Dimensional Tumour Growth Model for a Radiation Therapy Process Simulation</i> 29 August 2001
Nina Kalach	M.Sc.	Dave Rogers	<i>What Constitutes a Clinic-like Radiotherapy Photon Beam</i> 9 July 2001
Ken Nkongchu	M.Sc.	Giles Santry	<i>PVA-Fricke Hydrogels for Radiotherapy Dosimetry Using MRI</i> 4 September 2001
Matthew Wismayer	M.Sc.	Paul Johns	<i>Measurement of the Amorphous Coherent Scatter Form Factor by Using an X-Ray Powder Diffractometer</i> 24 October 2001

Table 5. OMPI Seminars, 2001-2002.

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
27 September 2001 Carleton University	Marco Carlone, <i>The Alpha/Beta Ratio for Prostate Cancer</i> Dave Rogers, <i>Monte Carlo Techniques for Radiation Dosimetry</i>
25 October 2001 Ottawa Heart Institute	Carey Feagan, <i>A Study of the Role of p21 in Thermal Radiosensitization</i> Madhu Dixit, <i>Scanned Projection Radiography with Photon Counting Proportional Detectors</i>
22 November 2001 Health Canada, Radiation Protection Bureau	Razvan Simionescu, <i>Flow Polarizing System for Hyperpolarized Xenon MR imaging of the Lungs</i> Barry McKee, <i>Quantitative Single-Photon Emission Computed Tomography (SPECT) in a Clinical Environment</i>
20 December 2001 Ottawa Hospital, General Campus	Richard Wassenaar, <i>Partial Volume Correction in Cardiac PET</i> Richard Richardson, <i>Antibody-guided radiotherapy of brain and spinal tumours</i>
17 January 2002 National Research Council, INMS	Lesley Buckley, <i>Characterization of the water-equivalence of phantom materials for $^{90}\text{Sr}/^{90}\text{Y}$ beta particles using the Novoste Beta-CathTM System</i> David Wilkins, <i>Compensating for Interruptions in Radiotherapy</i>
14 February 2002 Carleton University	Elena Olariu, <i>Monte Carlo studies of the MR diffusion decay</i> Julia Wallace, <i>Hyperpolarized Xenon For Magnetic Resonance Imaging of Breast Cancer</i>
21 March 2002 Ottawa Hospital, Civic Campus	Kenji Myint, <i>Modeling the radiotherapy treatment process with a knowledge-based expert system</i> Akhilesh Trivedi, <i>Risk of cardiovascular disease following radiation exposure</i>
18 April 2002 ORCC, General Campus	Dana Mullins, <i>Chronomodulation of Combined Topotecan and X-Radiation Therapy</i> Robert deKemp, <i>Serial Myocardial Perfusion Imaging with ECG-gated SPECT</i>

Table 6. Department of Physics Seminars in Medical Physics, 2001-2002.

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.

Date	Speaker, Institution, and Title
17 September 2001	Greg Cron, Carleton University, <i>The use of Magnetic Resonance Imaging and Intravenously Injected Contrast Agents to Measure Blood Flow in Tumours</i>
29 October 2001	David Wilkins, Ottawa Regional Cancer Centre, <i>Radiobiological Considerations in Prostate Cancer</i>
19 November 2001	Philippe Leblanc, Centre de Recherches du Centre Hospitalier de l'Universite de Montreal, <i>Endovascular P-32 Beta Irradiation using Radioactive Coils to Improve the Treatment of Cerebral Aneurysms ?</i>
3 December 2001 OCIP Fall Graduate Student Seminars	Gosia Niedbala, Carleton University, <i>Evaluation of Pulsed Dose Rate Irradiation With and Without Hyperthermia Using Two Breast Cancer Carcinoma Breast Lines</i>
18 December 2001 OCIP Christmas Symposium	Joanna Cygler, Ottawa Regional Cancer Centre, <i>Endovascular Therapy - A New Art of Treating the Broken Heart</i>
21 January 2002	Grant Nixon, MDS Nordion, <i>A Survey of Applied Radiation Physics at MDS Nordion</i>
25 February 2002	Donald Plewes, University of Toronto, <i>Micro-Scale Motion Imaging with MRI and MRI Elastography</i>
25 March 2002	Lothar Lilge, University of Toronto, <i>Biophotonics for biotechnology</i>
17 May 2002 OCIP Spring Graduate Student Seminars	Marco Carlone, Carleton University <i>Radiobiological Parameter Estimation for a Predictive Tumour Control Model for Early Stage Prostate Cancer</i>