Ottawa Medical Physics Institute (OMPI)
(the Medical Physics Organised Research Unit, Dept. of Physics, Carleton University)

Newsletter #11, June 1999

Editor: Jan P. Seuntjens

(Also on: http://www.physics.carleton.ca/research/OMPI/)

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The Ottawa Medical Physics Institute, an Organized Research Unit of Carleton University

The Ottawa Medical Physics Institute of Carleton University has 30 members involved with research and/or teaching in the Ottawa area. To provide a report on activities in the past year, this newsletter (pages 3-22) includes a membership profile including affiliation, current research, funding, and recent publications. The Medical Physics graduate students at Carleton are an important component of the Ottawa Medical Physics Institute. A student section in this newsletter (pages 31-33) lists their research topics and supervisors. The Executive meets about once a month and consists of a Director (Paul Johns), Past-Director (Ian Cameron), Secretary (Jan Seuntjens), Academic Officer (Giles Santyr), and a graduate student representative (Gosia Niedbala). Other members (Pavel Dvorak, Cheng Ng, and Robert DeKemp) attend executive meetings as observers. Pavel Dvorak has also coordinated the seminars for the past two years.

A Note from the Director

Summer is here and it's time to look back at another year of medical physics in Ottawa.

In the 1998-99 academic year OMPI welcomed three new members:

• David Wilkins - is a member of the medical physics staff at the Ottawa Regional Cancer Centre (ORCC). Dr. Wilkins is a graduate of the Carleton Physics program in medical physics. His training also included a postdoc and medical physics residency at the ORCC. His research interests are in radiation therapy and radiobiology.

• George Daskalov - did his early graduate work in nuclear physics in Sofia, Bulgaria and holds a PhD in nuclear engineering from the University of Tennessee. He is currently an Assistant Research Officer in the Ionizing Radiation Standards group at NRC. His interests focus on the radiation physics of brachytherapy. He has been working on applying the multigroup discrete ordinates method, a technique used in nuclear engineering, to photon calculations for brachytherapy.

• Julia Wallace - is a Research Associate in the Carleton Magnetic Resonance Facility. Dr. Wallace is a graduate of the Carleton Physics program in medical physics. Her current research interests are in MR imaging of hyperpolarized Xe and in MR thermometry.

A continued strength of the Carleton graduate program in medical physics is the quality of the courses. This year four half courses were offered: Medical Radiation Physics, which I taught; Radiobiology, by Peter Raaphorst; Physics of Medical Imaging, by Giles Santyr plus Barry McKee and myself, and Radiation Protection, by Elaguppillai. Special thanks to Peter Raaphorst, Barry McKee and Elagu for taking the time from their demanding schedules at their own institutions to make these courses available.

Five graduate student theses were completed in 1998-99. Miller MacPherson completed his PhD in July 1998 and is currently a medical physics resident at the ORCC. At the end of that summer Geoff Zhang defended his PhD. He is presently a staff physicist at JDS Fitel in Ottawa. Gosia Niedbala completed her MSc in December and is now a PhD student in our program. Daryoush Sheikh-Bagheri defended his PhD in January 1999 and is employed with the Computer Products section at Theratronics in Kanata. Tanya Hewitt completed her MSc in April and continues to work as a physicist in the Heart Institute PET Centre. She had been there part-time for the last several months of her degree.

The monthly OMPI seminars were well-attended this year. Thank you to all speakers and attendees. This year we also ran a soccer game and barbecue in the fall, a broomball game in the winter, and had a tour of Theratronics in May. We welcome suggestions for future social and/or educational activities.

The Ottawa Life Sciences Council is working hard to promote private sector development in biosciences and medical devices in our region. OMPI has been a corporate member of the Council since 1995 and was pleased to
organize a session of invited speakers at the Ottawa Life Sciences Conference in November 1998. The speakers were David Weber (General Electric, Milwaukee), Aaron Fenster (Robarts Research Institute, London Ontario), Giles Santyr (Carleton), and Peter Raaphorst (ORCC). We plan to continue to use this venue to publicize medical physics in this city.

In the winter and spring of 1999 the OCIP graduate program in Physics was the subject of site visits by three physicists, as part of the periodic OCGS appraisal of programs. Thank you to all the OMPI members and graduate students who participated in this. I have not yet seen the reports, but I believe that the collaborative model upon which our program is built was viewed very positively.

It is the OMPI Executive which holds our organization together and keeps things moving. Jan Seuntjens was elected to the position of Secretary of OMPI in December 1999. Our thanks go to Barry McKee who served as Secretary for the previous two years and who did a superb job. Giles Santyr was acclaimed for a second two-year term as Academic Officer. Gosia Niedbala has replaced Daryoush Sheikh-Bagheri as the student representative. And, after two years as Seminar Organizer, Pavel Dvorak will be giving up that responsibility and a new person will take over in September. Thank you Daryoush for bringing the students’ interests forward and thank you Pavel for two good years of OMPI seminars. Thanks go to all current members of the Executive for their drive and commitment to our activities of the next year.

In closing, thank you to all OMPI members and graduate students for your support in 1998-99. With our continued joint efforts we can look forward to another good year.

**OMPI Membership Profile including Recent Research**

In order that the Newsletter may serve as an annual report to the Dean of Graduate Studies and Research of Carleton University, this section describes briefly the research activities, recent publications, and sources of research funding of the OMPI members. The editor has imposed a standard format.

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**Recent Research:** Magnetic Resonance Imaging (MRI) is used to study water diffusion in human tissue. In order to better understand, at a basic level, the effects of water diffusion in MRI, the range over which the water molecules diffuse in a given time is measured for a variety of tissues and experimental conditions in human volunteers (completely non-invasively). These results are then interpreted using a combination of analytical models and simulations based on Monte Carlo algorithms. We have also designed and built special gradient coils which allow us to study this process over a much larger range of values than would otherwise be possible.

A second research area that we are involved with is known as functional MRI (fMRI). In fMRI the volunteer is asked to perform a specific task (e.g. finger tapping) and the part of the brain that is used to perform this task is detected. This research is applied to following the recovery of patients who have suffered a recent stroke.

Another research interest is in Hyperpolarized Noble Gas (HNG) MRI. With HNG MRI a special procedure is used to polarize noble gas molecules such that when inhaled by a patient they will produce a signal that can be used to generate an MRI image. This is a very new approach to MRI but it has a lot of potential.

**Funding:** Co-investigator on NSERC grant to support HNG MRI research. $200k/y
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Recent Research: Studying the use of highly focussed beams of ultrasound for the reduction or removal of benign and malignant lesions. The process of tissue destruction, consisting of energy deposition, diffusion and tissue response is being studied experimentally, theoretically and by computer modelling. Appropriate lens design and the dosimetry of high intensity ultrasound are also being investigated. Ultrasound tissue lesioning needs accurate temperature measurement as a function of space and time. The most promising technique uses quantitative results from MRI. Work has been started on measuring the point spread function and time dependence of an MRI temperature measuring system.

Publications:

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Recent Research: In the area of clinical electron beam dosimetry the verification process of the new electron beam algorithm implemented in Theraplan Plus is in progress. This algorithm attempts to use a similar approach to dose calculation as has been successfully used for photon beams. One of the explicitly required parameters to describe an electron beam is a Peak Scatter Factor, PSF. Rigorous tests are being performed to evaluate the performance of this algorithm. A special set of carefully machined phantoms with inhomogeneities of various densities embedded in them is used to carry out the verification tests. Measurements and calculations of Electron Peak Scatter Factors as a function of field size and beam energy are in progress. In parallel to this project, an effort of clinical implementation of electron beam calibration at a new reference depth is carried on. Collaboration with the NRC scientists within the OMEGA project is continued. Clinical implementations of new dosimetry devices (MOSFETS and gafchromic films) are carried on in collaboration with the Canadian industry and scientists from the NRC.

Studies of biological equivalence of high dose rate (HDR) and pulse dose rate (PDR) brachytherapy treatments have been started in collaboration with other scientists from ORCC. Irradiations of human glioma cells and normal human fibroblasts will be carried on under several different fractionation regimes. Amount of biological damage to cells will be measured using asymmetric field inversion gel electrophoresis and other modern techniques.

Publications:

**George Daskalov**

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**Recent Research:**
- Semi-analytical approach in heterogeneity correction factor determination within the framework of the scatter-subtraction dosimetry model in brachytherapy.
- Development of multigroup photon cross section libraries for brachytherapy dosimetry calculations.
- Multi-dimensional discrete ordinates modeling of I-125 and Ir-192 brachytherapy sources dosimetry.

**Publications:**

**Robert deKemp**

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**Recent Research:** Development of three-dimensional attenuation and scatter corrections for positron emission tomography, and automated 3D cardiac image analysis and interpretation. Current efforts are focused on kinetic modelling of $^{82}$Rb blood flow and $^{18}$FDG metabolism measurements. New control algorithms will be developed for the $^{82}$Rb isotope delivery system, to allow precise control of infusion dose rates as well as total injected dose and volume.

**Funding:** MRC grant $55k/y. Evaluating new treatments for heart disease using dynamic PET.

**Publications:**
Madhu Dixit (Associate Member)

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Recent Research: Experimental elementary particle physics, weak interactions, development of new detectors and instrumentation for particle physics and applied physics. Present interests are: OPAL experiment at CERN and the development of gas microstrip detectors for digital x-ray imaging for medical and industrial applications and for radiation dosimetry.

Publications:

Pavel Dvorak

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Recent Research: Studies of patient doses from x-ray procedures, computer simulations of x-ray procedures, development of testing and measuring techniques, both in medical and non-medical x-ray applications. Facilities: Three phase and single phase radiographic/fluoroscopic, mammographic, dental and industrial x-ray machines, assorted phantoms, measuring equipment an automatic film processor and an x-ray spectrometer.

V Elaguppillai

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Recent Research: Quantification of the risk to health (cancer, genetic and teratogenic effects) and environmental effects of exposure to low dose and low dose-rate of low and high LET ionising radiation, reduction of uncertainties in risk estimates, design and improvement of radiation practices at work places (hospital, research, power reactor, uranium mine, mill and refinery, radioactive waste disposal facilities) are the areas of main research interest.
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Recent Research: In our present work we are developing a methodology by which one can perform a cost benefit analysis of new technology and proposed changes to patterns of practice in radiation therapy. This tool will provide a rational basis upon which we can:

- Make equipment purchase decisions
- Make patterns of practice decisions
- Determine the optimal distribution of limited resources

Cancer treatment is in many ways similar to the manufacturing industry, whereby raw product is input into a system or process and a product is produced. In cancer treatment the "input" is the patient and the resources of the health care system. These are both funneled into the cancer treatment process and the outcome for the general population is statistical, that is a certain percentage of the patients are cured, the rest are not. For the individual the outcome is binary, either they are cured or they are not. In industry, if a process has a significantly high failure rate, whereby the product does not meet specification, the process is examined and the source of failure is identified and corrected. The various stages of the process are quality assured during manufacturing by statistical sampling. The more stringent the sampling process, the better the quality control on the product. In general this approach is not applied to cancer treatment. That is, when two seemingly identical patients enter the treatment process and one is cured while the other is not, very little is done to examine the process to determine where the failure occurred. The difference is ascribed to "biological variability". Indeed there is biological variability and much of the statistical nature of what is seen clinically can be attributed to it. However, there may also be a large, but unmeasured, variability in the day to day "treatment" process which could also play a significant role.

We are developing a model by which we can examine the entire radiation cancer treatment process, including staging, imaging, prescription, treatment planning and finally treatment delivery. The model treats the radiation therapy process as a linear chain, in that information is collected and passed from one stage of patient care to the next. The output of one stage acts as the input for the next. As a simple example, staging is determined based on the results of many tests including biochemistry, imaging and physical examination. Thus the output of the testing acts as the input for determination of the target volume. This chain continues and culminates in the delivery of treatment. As a result of the temporal and spatial dose actually delivered the patient experiences an outcome (product). Thus, any weakness or error in any part of the chain will contribute to a reduced probability of a favorable outcome. In order to achieve optimal improvement in the system with finite resources the weakest links in the chain must be identified.

The model is coupled to a biological response in order to predict outcome. We have chosen for this model the linear quadratic model with a repair term and Gompertzian growth kinetics and we will use Normal Tissue Complication Probability (NTCP) and Tumor Control Probability (TCP) as our endpoints. Combining all of these elements we hope to develop a model which would help predict the impact of various changes of practice and the introduction of new technologies. Integrating this with estimates on the cost (negative or positive) of the changes one can then make a predictive cost benefit analysis.

Publications:
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Recent Research: Studying radiation-induced conformational changes to the human genome in living cells using time-resolved and immunofluorescence spectroscopies. Using electron spin resonance (ESR) bio-dosimetry of human samples or tissue-equivalent surrogate samples. Developing an automated multiwell cell survival assay using a redox dye as a vital stain for quantitative studies of biological response modification and the radioprotective action of antioxidants. Exploring the lymphocyte immunosurveillance system as an early-warning system for radiation, cancer-proneness, cell signalling and adaptation. An immunoassay technique (ELISA) has been set up to measure antioxidant levels in cells, and to examine their role in protecting against radiation, cancer and aging. Applying health physics and radiation protection to risk assessment.

Funding:
AECL core operational and special projects funding.

Publications:
- C.L. Greenstock, “Radiation quantities and units”, AECL Publication, RPM-5.4, pp.6, 1997
Boguslaw Jarosz

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Recent Research: - Ultrasound waveguide interstitial applicator has been studied in the past for its use in hyperthermia, adjuvant modality of cancer treatment. Currently studies were initiated of use of the applicator array for thermal therapy. The main interest relates to minimally invasive treatment of brain gliomas. In the procedure, two to six applicators in the array are proposed for heating. We investigate temperature pattern in tissue phantoms. FEA modelling of heating effects provides additional information on power required from individual applicators. The modelling enables appropriate planning of applicator location that results in best lesion coverage with minimal heat toxicity.
- In thermal treatment of cancer knowledge of blood flow is considered as an important factor for the treatment success. In FEA modelling described above effective thermal conductivity approach has been used. Recently we started modelling the tissue with discrete blood vessels included in the most sensitive areas. In the modelling vessels shape and size, their location relative to an applicator and blood flow velocity are studied. Proper modelling of heating effects requires information of ultrasound/tissue interaction. We are investigating this effect as well laser generated ultrasound for heating.

Funding: NSERC operating grant $18k/y.

Publications

Paul Johns

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Recent Research: - Investigating means of obtaining diagnostic information using coherent and incoherent scatter. Although coherent scatter has a small cross section compared with Compton scattering, it is a forward directed process, so that coherently-scattered photons have a high probability of reaching the image receptor. Furthermore, the differential coherent cross section varies with scattering angle and photon energy in a material-specific manner, even for amorphous materials; this is the diffraction signature of the material. This dependence on Z and chemical structure suggests that it can be used to obtain chemical information about tissues. We are in the process of a detailed investigation of scatter imaging to determine its sensitivity, i.e. the radiation dose to the patient required to detect the presence of a volume of tissue of specified dimensions against a background of other tissue.
- Member of collaboration at Carleton investigating the use of gas microstrip detectors for medical x-ray imaging. By operating in photon counting mode, the energy of each photon event can be measured, providing input for applications such as dual-energy radiography.
- Studying iterative reconstruction techniques to reduce artefacts in computed tomography (CT) by accounting for the polyenergetic nature of the x-ray beam as well as scattered x-rays.

**Funding:**
NSERC Operating Grant  $15.4k /y
Carleton University GR-5 Funding (Installation of Donated X-Ray Angiography Equipment) $5k

**Publications:**

**Iwan Kawrakow**

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**Recent Research:**
- Electron transport theory,
- Monte Carlo techniques,
- Theoretical dosimetry

**Publications:**

**Norman Klassen**

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**Recent Research:** Involved in the work to establish absorbed dose standards based on water calorimetry. This is being done for high energy photons and Co-60 beams. The temperature rise in the water, caused by the absorbed dose, has a component which is due to chemical changes in the aqueous absorber. This component is simulated by computer and the simulations are tested by measuring the hydrogen peroxide in the irradiated aqueous systems. Recently, a method was developed for using GafChromic MD-55 (a thin film dosimeter) as a transfer dosimeter with an uncertainty of less than 1%. An effect of polarized light on GafChromic MD-55 was discovered and explained.

**Publications:**

**Gabriel Lam**

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**Recent Research:** - Radiotherapy using charged particle beams including negative pi-mesons and protons. Development of dosimetry and beam delivery techniques for particle beams.  
- Theoretical radiobiology of combined effects of mixtures of radiations of different qualities. Investigation of the general concept of effective dose in radiobiology and in radiotherapy.  
- Theoretical studies of interaction of toxic agents. Development of general interpretation and definition of synergism and antagonism for mixtures of toxic agents with different mechanisms of action.

**Publications:**

**Barry McKee**

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**Recent Research:** - Developing a high-resolution pinhole SPECT camera that will achieve a resolution of about 4 mm over a limited field of view. Various image reconstruction methods are being explored. Pinhole
tomography should be useful for clinical imaging of the thyroid, and for research applications in radiopharmaceutical development.
- Modelling and measuring the scatter background in SPECT systems to develop and test improved correction methods.

Publications:

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Recent Research: The ability of drugs to potentiate the response of human cancer cells to X-radiation and hyperthermia is being investigated. The aim of these experiments is to determine if the inhibition of cellular repair of X-radiation damage or the interaction of the drugs with hyperthermia can lead to selective killing of human tumour relative to normal cells. A selective killing of tumour over normal cells is necessary to treat tumours successfully in the clinic. In particular, two types of drugs, DNA topoisomerase poisons and cisplatin, are being emphasized. Both of these drugs are already in active use clinically; the DNA topoisomerase poisons, in particular, are also being investigated as an adjunct to radiotherapy of cancer. Recent work has also focussed on the role of the tumour suppressor, p53, in the modulation of killing by the topoisomerase poisons.

Funding: Supported as a Career Scientist with CCO.
-NCIC (Principal Investigator) interaction between X-radiation and topoisomerase poisons, $99k/y;
-ORCC Foundation (Principal Investigator) mechanisms of resistance in human pancreatic tumour cells,$10k;
-NCIC (Co-investigator)interaction of cisplatin with X-radiation and hyperthermia, $128k/y;
-NCIC grant (Co-investigator) cellular radiosensitivity, $70k.

Publications:
- Ng, C.E. “Radiobiology: Mobilizing physics and chemistry for the battle against cancer. Challenge, Life with Cancer”, Magazine of the Ottawa Regional Cancer Centre, 16-17, Fall/Winter 1998.
Peter Raaphorst

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Recent Research: Presently there are three main areas of research as follows:
- The study of radiosensitization of human cancer cell to radiation using hyperthermia and drugs. This project includes the study of the response of a wide range of human tumour cells (glioma, ovarian carcinoma, breast cancer, melanoma etc) to radiation at different dose rates and the effect of hyperthermia (heating from 40 to 45°C) on radiosensitization. In addition the effect of chemotherapy agents in combination with hyperthermia and radiation is also being evaluated. In these studies we are also assessing the mechanisms of radiation resistance and the capacity of cells to repair radiation damage. The experimental results are being modelled in order to developed comprehensive models that can be used to predict radiotherapy outcome. These studies also include design of special radiation apparatus to deliver specific dose rates and require the development of a good understanding of radiation dosimetry.
- Prediction of radiation response. In this study we are evaluating the response of human normal and tumour cells in culture to irradiation. The normal and tumour cells are obtained from patients before undergoing radiation therapy and are assessed for the radiation response and then compared to the response of the patient undergoing radiotherapy. To date we have found a correlation between the in-vitro and the patient tissue response. Further studies are ongoing to model these responses and to determine whether the results can be used as a predictor of radiation sensitivity and for customized dose prescription in order to optimize radiotherapy.
- Induction of radiation resistance with low doses of radiation. Our preliminary studies have shown that low dose and low dose rate irradiation can induce radiation resistance in human cells. This can have a major impact on radiation therapy where in some cases radiation is given either in fractions or at low dose rate. In addition such resistance can also have an impact on working in low level radiation fields such as those found in some industries or in outer space. We are currently characterizing this induced resistance in human cells and will develop strategies for its optimization. In addition we are also looking at other means to induce or possibly prevent induction of radiation resistance. These results are being put into models to help predict the radiotherapy response.

Funding:
- NCIC Grant for the study of cellular radiation resistance and methods of sensitization $101k/y for 3 y
- NCIC Grant for the study of combined treatment of radiation cisplatin and hyperthermia. $106k/y for 3 y
- Department of Defence funding for the study of induced radiation resistance. $23k/y.

Publications:

**Richard Richardson**

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**Recent Research:**
- Developing, with Dave Dunford, an internal dosimetry Microsoft WINDOWS-based code, called GENMOD that calculates the radiation dose to the lung and other organs.
- Investigating the subcellular dosimetry for tritium-contaminated intakes in collaboration with research workers at Carleton University and AECL.
- Internal dosimetry of tritium and carbon-14 in diet.
- Leader of the Human Dosimetry project group, of the International Energy Agency's “Cooperative Program on Environmental, Safety and Economic Aspects of Fusion Power”

**Research Funding:** Dosimetry of organically bound tritium derived from diet. AECB, Canada (1996-Present)

**Publications:**

Dave Rogers

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Recent Research: - Monte Carlo techniques are used to calculate correction factors required for primary radiation standards. Recent examples are the calculation of wall correction factors for ionization chambers used for air kerma standards, and the calculation of the wall effect for Fricke dosimeter vials. These correction factors have a significant impact on several national standards.
- Developing more accurate and easily used clinical dosimetry protocols. In this regard, the effect of beam size and beam quality on ionization chamber calibration factors is being calculated. Also, work is underway on a formalism which will use absorbed dose, rather than exposure, calibration factors.
- Measuring fundamental data using the NRC linear accelerator. A recent project has accurately measured the bremsstrahlung yield from thick targets as a function of energy and angle and compared the results to Monte Carlo calculations. Another project is underway to measure electron stopping powers which play a fundamental role in radiation dosimetry but have never been measured with an accuracy of better than 5%.
- Working on the OMEGA project. This is a collaboration with Rock Mackie's group at the University of Wisconsin to develop a Monte Carlo based code to calculate the dose in a patient undergoing electron beam radiotherapy. We are developing a general purpose code to model radiation beams from clinical accelerators.

Funding: - NIH - $125k/y for 3 y for the project “Improved photon beam and $^{192}$Ir clinical dosimetry”.

Publications:

Douglas Salhani

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Recent Research: - The knowledge of the photon spectrum from medical linear accelerators improves the quality and accuracy of the radiation dosimetry. The spectral shape strongly influences the dose distribution in the patient especially in the presence of heterogeneities, correction factors required for beam calibration, and unit head design. Additionally, the spectrum shape plays a role in dose calculations involving beam modifying devices. Direct measurement of a photon spectrum is not possible in a clinical environment. As a result, approximate methods for estimating these spectra must be considered. In our work, an integral equation formulation for unfolding x-ray spectra from transmission data is being studied. The integral equation to be solved is a Fredholm type of the first kind which is, in general, extremely difficult to solve. Our approach is to transform this to a Fredholm type of the second kind, which is handled much more readily using standard numerical methods such as collocation or Galerkin methods. This approach promises to be challenging and has direct application to other areas of medical physics including the inverse-planning problem.

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520-2600x8996 (voice) 520-4061 (fax) santyr@physics.carleton.ca (e-mail)

Recent Research: - The general goal of our research is to develop new Magnetic Resonance (MR) imaging methods for improved patient care. Our primary clinical focus is breast cancer. Current research activities in our laboratory include: the use of spin locking and magnetization transfer contrast for improving detection of lesions in radiodense breasts, characterization of breast lesions (benign vs. malignant) using rapid imaging of gadolinium-based contrast agents, measurement of tumour blood flow and 3-D image display issues. Clinical studies to evaluate the usefulness of these techniques are in progress. Our clinical collaborators include The Ottawa Hospital, General Site (see: Ian Cameron), the Kingston General Hospital and the Children’s Hospital of Eastern Ontario. A relatively recent area of research involves the imaging of hyperpolarized noble gases (HNG), in particular $^{129}$Xe and $^3$He. As part of an NRC/NSERC Research Partnership, we are investigating the large-scale production, storage, transport and delivery of HNG as well as MR imaging applications for both in vivo imaging of gas and dissolved phases (e.g. blood flow) and non-biological material testing. This collaborative research involves investigators at the NRC Steacie Institute for Molecular Sciences as well as The Ottawa Hospital, General Site.

Funding:
- NIH FIRST Award from NCI: "Spin locking for magnetic resonance imaging of breast cancer", $100k/y.
- Heart and Stroke Foundation of Canada (Co-Investigator):”Chronic Ischemia of Brain and Retina”, awarded 04/99-04/03, $68k/y.

Publications:
Jan Seuntjens

Ionizing Radiation Standards, Institute for National Measurement Standards
National Research Council of Canada
Ottawa, Canada, K1A 0R6
993-2715 (voice) 952-9865 (fax) jan.seuntjens@nrc.ca (e-mail)

Recent Research: - Successful treatment of tumors using radiotherapy requires accurate knowledge and verification of absorbed dose delivered by the treatment unit. The first step in determination of the dose to the tumor is calibration of the treatment unit in terms of the quantity absorbed dose to water. The IRS group is working on calibration methods to allow the clinical physicist to directly determine absorbed dose to water with unprecedented accuracy. These methods are based on the calibration of ionization chambers, the commonly used instrument in clinical dosimetry, in terms of absorbed dose by comparing them with a water calorimetric technique. Using calorimetry the dose can be determined from first principles by measuring the temperature rise in water caused by radiation. The Canadian standard for absorbed dose to water is now based on the sealed water calorimeter.

- In one part of the work we concentrate on establishing the water calorimetry technique to measure absorbed dose in Co-60 beams, and linear accelerator photon and electron beams. Various high precision measurements and numerical modeling of heat transport in water have improved our understanding and correction factors on the sealed water calorimeter.

- In a second part of the work we use the water calorimeter to measure absorbed dose beam quality dependence correction factors (k_Q) of commonly used cylindrical ionization chambers in high energy photon beams. By studying these correction factors various problems in the procedures currently employed by the clinical physicists can be identified. This part of the project goes hand in hand with Monte Carlo simulations, in order to understand the various effects related to wall correction factors of ion chambers.

- In the framework of the American Association of Medical Physicists' RTC Task Group No 61, we are working on a new dosimetry guide for kV X-rays for clinical physicists and radiobiologists. Various smaller research projects and publications are carried out to optimize the recommendations of the new protocol.

Publications:
- C.M. Ma, X.A. Li, and J.P. Seuntjens Consistency study on kV dosimetry, *Proceedings of the kV X-Ray Workshop*, Stanford University, eds C.-M. Ma and J.P. Seuntjens p 69 – 88, 1999
Ken Shortt

Ionizing Radiation Standards, Institute for National Measurement Standards
National Research Council of Canada
Ottawa, Canada K1A 0R6
993-2715 (voice) 952-9865 (fax) kshortt@irs.phy.nrc.ca (e-mail)

Recent Research: The National Research Council declared a new standard of absorbed dose to water in July, 1998. A series of comparisons of the dosimetric standards of NRC with the corresponding standards of the US, France, Switzerland and the BIPM was carried out in the fall of 1998. Collaborative research with Giles Santyr and Julia Wallace of Carleton University in the field of gel dosimetry is progressing nicely. The energy dependence of $G$, the yield of ferric ions produced by irradiating Fricke chemical dosimetry solution has been studied and a paper in press. The relative value of the absorbed dose calibration factor for a variety of commercially produced transfer ionization chambers, called $k_Q$, is also under investigation at several linac energies. A paper on this is in preparation. Radiation detector development with industrial collaborators is continuing as are experiments in radiation protection using TLDs.

Publications:

Jason (Jiansheng) Sun

Computer Products, Theratronics, 413 March Road, P.O. Box 13140,
591-2100x2256 (voice)  592-6559 (fax)  sun.j@theratronics.com (e-mail)

Recent Research:
- 3-D external beam, brachytherapy and stereotactic radiosurgery dose calculation algorithms
- Radiation treatment planning optimization methods
- Dynamic radiotherapy techniques and their implementation in 3-D radiation treatment planning systems

Publications:
Janos Szanto
Ottawa Regional Cancer Centre, Department of Medical Physics
501 Smyth Rd
Ottawa, Ont, K1Y 8l6
737-7700 x 6741 (voice) 247-3507 (fax) jszanto@cancercare.on.ca (e-mail)

Recent Research: - Design and Dosimetry of a Fractionated Stereotactic Radiotherapy System.
At the Ottawa Regional Cancer Centre we have developed a unique system for the delivery of fractionated stereotactic radiotherapy. Patients are immobilized in a very accurate, stable, reproducible, non-invasive, relocatable stereotactic frame which is based on a custom made Cobalt-Chrome bite-block that locks into the undercuts of the teeth. The patient motion is measured by our optically based patient position monitoring system and found to be within ±1mm.

The dosimetry of small, high energy X-ray beams has been investigated both experimentally and by Monte-Carlo calculations. Some difficulty arises from the lack of lateral electronic equilibrium and the detectors’ relatively large sizes.

Akhilesh Trivedi (Associate Member)
Radiation Biology and Health Physics Branch, Atomic Energy of Canada Limited
Chalk River, Ontario, K0J 1J0
(613) 584 3311 x 4764 (voice), (613) 584 1689 (fax), trivedia@aecl.ca (e-mail)

Recent Research
(i) Health effects and dosimetry of tritium and 14C-related compounds.
(ii) Development of physiologically based metabolic models for dose assessment
(iii) Radioecological dosimetry and ecological risk assessment.
(iv) Development of advanced bioassay techniques for monitoring ultra low-levels of radionuclides in biological samples.
(v) Biomarkers for the biological dosimetry.
(vi) Radiobiology of low-dose low dose-rate exposures and risk prediction.
(vii) Cellular and molecular biological effects of exposure to environmental factors.
(viii) Risk of tumorigenesis and carcinogenesis in living systems.
(ix) Membrane biogenesis and bioenergetics

Funding:
- CANDU Owners group (COG) contract for advanced bioassay development program, $70 k;
- Atomic Energy Control Board (AECB) contract for OBT-in-diet dosimetry, $65 k;
- AECL R&D support for tritium and carbon-14 dosimetry, $110 k.

Publications:
- A. Trivedi, D. Galeriu and E.S. Lamothe “Dose contribution from metabolised organically bound tritium after chronic tritiated water intakes in human” *Health Phys.* (in press)

**Tony Waker**

AECL, Radiation Biology and Health Physics Branch, Chalk River Laboratories
Chalk River, Ontario, K0J 1J0
613 584-8811 x 3610/3611 (voice) 613 584-1713 (fax) wakera@aecl.ca (e-mail)

**Recent Research:** - The application of microdosimetric methods and counters in radiation protection mixed field dosimetry and monitoring with particular emphasis on the radiation environment within CANDU power plants. The development of low pressure tissue equivalent proportional counters with enhanced sensitivity and collaborative work on the dosimetric properties of Gas Microstrip Detectors developed at Carleton University and the Centre for Research in Particle Physics at Carleton. The development of experimental methods based on laser desorption and time-of-flight mass spectrometry for the study of radiation damage to DNA as part of a program of microdosimetry at the molecular level for studying fundamental aspects of radiation quality.

**Publications:**
OMPI Newsletter, June 1999


**Julia Wallace**

Carleton Magnetic Resonance Facility, Physics Department, Carleton University, Ottawa, Ontario K1S 5B6
Phone: (613) 520 2600 x1073 Fax: (613) 520 4061 e-mail: jwallace@physics.carleton.ca

**Recent Research:** - Our group is developing MR imaging methods to detect and diagnose disease and to contribute to the treatment of diseases. - We are investigating the accuracy of MR thermometry for monitoring tissue temperatures during focused-ultrasound thermal therapies. - We are also evaluating BANG dosimetry gels for equipment calibrations and for 3D visualization of prescribed radiation treatments. - In addition, we are investigating the use of both established and novel contrast agents for the early diagnosis of breast cancer.

**Funding**
Co-investigator on Canadian Breast Cancer Research Initiative grant. $35k

**Publications**

**David Wilkins**

Ottawa Regional Cancer Centre, Department of Medical Physics
501 Smyth Road
Ottawa, Canada K1H 8L6
737-7700 x 6826 (voice), 247-3507 (fax), dwilkins@cancercare.on.ca (e-mail)

**Recent Research:** - Radiation therapy is normally delivered in discrete fractions over a period of weeks, partly to allow for repair of radiation damage to normal tissue. The rates of repair of tumour and normal cells are rarely known for a particular patient, but radiobiological data from cultured cells can provide estimated values.
During extended fractionated treatments, the effects of tumour proliferation can, in some cases, become important to the overall treatment outcome. Computer models, based on the linear quadratic model of cell survival and the Gompertzian-Exponential model of tumour proliferation, have been formulated to provide a tool for evaluating the effectiveness of particular fractionation schemes. These models are being used to evaluate novel fractionation schemes such as hyperfractionation and pulsed dose rate brachytherapy, as well as to evaluate the effects of unplanned treatment interruptions on treatment outcome for rapidly proliferating tumours.

- Other areas of research include cellular evaluation of the biological equivalence of high dose rate, pulsed dose rate and low dose rate brachytherapy, and evaluation of the clinical utility of various radiation detection devices.

Publications:

Curricula Vitae of New Members

George Daskalov

**EDUCATION**
- 1996  Ph.D in Nuclear Engineering, University of Tennessee, Knoxville, TN
- 1994  Ph.D. in Nuclear Physics, Bulgarian Academy of Sciences, Sofia, Bulgaria
- 1977-1982  B.Sc. & M.Sc. in Physics, Sofia University, Sofia, Bulgaria

**PROFESSIONAL EXPERIENCE**
- 1997-present  Assistant Research Officer, IRS/INMS, NRC of Canada, Ottawa, Ontario
- 1996-1997  Researcher, Mallincrodt Institute of Radiology, Washington University Medical School, St. Louis, MO
- 1992-1995  Research assistant, University of Tennessee, Knoxville, TN.
- 1990-1992  Research Fellow, Institute for Nuclear Research and Nuclear Energy, Sofia, Bulgaria
- 1984-1990  Researcher, Institute for Nuclear Research and Nuclear Energy, Sofia, Bulgaria

**RESEARCH AND DEVELOPMENT INTERESTS**
Development and implementation of analytical and numerical methods for solving the radiation transport equations. Applications to three-dimensional conformal treatment planning for clinical radiation cancer treatment.

**PROFESSIONAL AFFILIATIONS**
Member American Association of Physicists in Medicine

**SAMPLE PUBLICATIONS**

**Julia Wallace**

**EDUCATION**

1996  Ph.D., Physics, Carleton University, Ottawa, ON, Canada
1985  M.Sc., Biophysics, University of British Columbia, Vancouver, BC, Canada
1983  B.Sc., Math and Physics, University of New Brunswick, Fredericton, NB, Canada

**PROFESSIONAL EXPERIENCE**

1997 – present  Research Associate, Physics Department, Carleton University
1988 – 96  Researcher, Institute for Biodiagnostics, National Research Council
1986 – 88  Research Scientist, Department of Physics, University of British Columbia

**RESEARCH AND DEVELOPMENT INTERESTS**

Our group is developing MR imaging methods to detect and diagnose disease and to contribute to the treatment of diseases. In particular, we are investigating MR thermometry for monitoring minimally invasive thermal therapies, BANG dosimetry gels for 3D visualization of prescribed radiation treatments and the use of novel MR contrast agents for the early detection and diagnosis of breast cancer.

**PROFESSIONAL AFFILIATIONS**

International Society for Magnetic Resonance in Medicine (ISMRM)
Canadian Organization of Medical Physicists (COMP)

**SAMPLE PUBLICATIONS**

Dave Wilkins

EDUCATION
1993  PhD, Medical Physics, Carleton University
1986  MSc(A), Medical Physics, McGill University
1979  BSc(Honours, Physics), Queen’s University

PROFESSIONAL EXPERIENCE
1997-present  Medical Physicist, Ottawa Regional Cancer Centre
1995-97  Medical Physics Resident, Ottawa Regional Cancer Centre
1993-95  Postdoctoral Fellow, Medical Biophysics Lab, Ottawa Regional Cancer Centre

PROFESSIONAL CERTIFICATIONS AND AFFILIATIONS
Member of the Canadian College of Physicists in Medicine
Peer Review ‘A’, Cancer Care Ontario
American Association of Physicists in Medicine, Member
Canadian Organisation of Medical Physicists, Member
Radiation Research Society, Member

CURRENT RESEARCH INTERESTS
- Radiobiological modeling of tumour and normal tissue response to radiation therapy
- Computer modeling of tumour progression
- Evaluation of the clinical utility of various radiation detectors

SAMPLE PUBLICATIONS
Seminars

OMPI Seminars

One of the main vehicles of the OMPI for developing and maintaining contact is through a seminar series in which all the members and the graduate students in medical physics are required to make a presentation. Seminars are scheduled monthly, and for the last several years have been held at 3:30 p.m. on Thursdays. The seminar location is rotated among the major centres involved in medical physics. Seminar information is posted on the web at http://www.physics.carleton.ca/research/OMPI.

Following is a list of OMPI seminars held in 1998-99. The second speaker listed is a graduate student.

**Thursday, September 17, 1998 at Carleton University**

Barry McKee (Ottawa Hospital)  
*Beyond “picture archiving” in nuclear medicine*

Malgorzata Niedbala (Carleton U.)  
*Effect of pulsed dose rate on three cell lines with and without hyperthermia*

**Thursday, October 15, 1998 at ORCC (General Division)**

David Wilkins (ORCC)  
*Models of fractionation and tumour progression in radiotherapy*

Daryoush Sheikh-Bagheri (Carleton U.)  
*Monte Carlo simulation of photon beams from medical linear accelerators: optimization, benchmark, and application*

**Thursday, November 19, 1998 at Theratronics**

George Daskalov (NRC)  
*Dosimetric modelling of the Microselectron high dose rate Ir-192 source by the multigroup discrete ordinates method*

Pascale Sevigny (Carleton U.)  
*Magnetic resonance (MR) imaging of hyperpolarized xenon gas*

**Thursday, December 10, 1998 at the Ottawa Life Sciences Technology Park**

Richard Richardson (AECL)  
*The measurement and theoretical estimate of the radiation dose from radon and other alpha emitters*

Robert Leclaire (Carleton U.)  
*Information content accessible with x-ray scatter imaging*

**Thursday, January 21, 1999 at the National Research Council**

Elagu V. Elaguppillai (ICLDRR)  
*Activities of the International Centre for Low Dose Radiation Research, University of Ottawa*

Tanya Hewitt (Carleton U.)  
*Characterization of a half circle pinhole tomograph for emission tomography*

**Thursday, February 18, 1999 at Carleton University**

Lee Gerig (ORCC)  
*A study of linear accelerator head scatter factors*

Kenji Myint (Carleton U.)  
*Cisplatin radiosensitization in radiotherapy*

**Thursday, March 11, 1999 at the Ottawa Hospital - Civic Campus**

Janos Szanto (ORCC)  
*Stereotactic radiotherapy*

Mei Li (Carleton U.)  
*Introduction to the China Institute for Radiation Protection*

**Thursday, April 15, 1999 at the Radiation Protection Bureau, Health Canada**

Julia Wallace (Carleton U.)  
*MRI thermometry of tissue during heating*

Yvan Gauthier (Carleton U.)  
*Measurement of water diffusion in the brain using NMR: phantom study and Monte-Carlo simulations*

**Carleton University Physics Department Seminars**

Carleton University Physics Department runs a regular seminar series usually on Monday afternoons (with overflow to other days of the week) at 3:30 p.m. in the Herzberg Building. Information on upcoming seminars is posted on the web. (http://www.physics.carleton.ca/seminars). The following seminars of interest to medical physicists were held in 1998-99:

**October 5, 1998**  
C.-M. (Charlie) Ma, (Stanford University School of Medicine): “Monte Carlo treatment planning for intensity-modulated radiotherapy (IMRT)”

November 9, 1998  Leszek Ropelewski (CERN): “GEM Gas Electron Multiplier: Recent Developments”


Friday December 18, 1998  OCIP Christmas Symposium – Bog Jarosz (Carleton University): “Ultrasound interstitial applicators for cancer thermal therapy”; Madhu Dixit (Centre for Research in Particle Physics): “Recent Developments in Gas Avalanche Microdetectors”

January 18, 1999  Robert Clarke (Carleton): “High Intensity Focused Ultrasound Surgery – a progress report”

February 1, 1999  Alan E. Nahum (Institute of Cancer Research & Royal Marsden NHS Trust, UK): “Tumour Control Probability Modelling and the ∆TCP Concept”


March 8, 1999  Dave Rogers (NRCC): “Improving cancer care by simulating the transport of ionizing radiation”


OCIP Graduate Student Seminars

Student seminars organized by the Ottawa-Carleton institute of Physics. The titles mentioned below only represent the medical physics related student seminars.

November 27, 1998, Fall Seminars
- Narine Kizilian, Carleton U.: “Predicting Radiosensitivity using the Comet Assay”

June 3, 1999 - Spring Seminars
- Pascale Sevigny, Carleton U.: “Magnetic Resonance Imaging of Hyperpolarized Xenon in the Dissolved Phase”
- Yvan Gauthier, Carleton U.: “Measurement of water diffusion in the brain using NMR: phantom study and Monte-Carlo simulations”

Other Seminars of Interest to the OMPI

In addition to the seminars listed in the above sections, there are a variety of other seminars in the Ottawa area which are of interest to the OMPI. The ones which have been brought to our attention over the last year are noted below:

- Nigel E.A. Crompton, (Paul Scherrer Institute, Switzerland) gave a seminar at the ORCC on Thursday, September 10, 1998. Title: “Radiotherapy patients displaying increased toxicity have altered apoptotic profiles”
- Albert R. Cross, (MRI Centre, University of New Brunswick) gave a seminar at the NRC Steacie Institute for Molecular Sciences on Monday, December 7, 1998. Title: “Maximizing Magnetic Resonance Imaging Parameters – Two different examples”
- Keith U. Ingold (NRC, Canada) gave the Gerhard Herzberg Lecture at Carleton University on Thursday March 11, 1999. Title: “Free Radicals, Antioxidants, and Human Health”
- Monique Frize (Carleton University / University of Ottawa) gave a lecture in the framework of the IEEE EMBS Ottawa Chapter Series at Carleton University on June 15, 1999. Title: “Information Technologies applied to Medicine: Current and Future Trends”

IRS informal Seminar Series. These seminars usually deal with radiation physics and dosimetry, Monte Carlo calculations, instrumentation and electronics, but can occasionally be about more broad topics. The speakers are members of the IRS group (National Research Council) as well as external visitors. The usual time is 10:30 unless otherwise indicated. Seminar organizer: Blake Walters.
**Medical Physics Graduate Courses**

The Carleton medical physics program has three specializations: imaging, therapy and biophysics. Shown below is the menu of courses for each. Required course numbers are printed in **underlined bold font**; the others are recommended.

Depending on the thesis weighting, the Ph.D. typically requires four half-courses in addition to the thesis. The normal M.Sc. course requirement is 5 half-courses in addition to the thesis. Ph.D. students who lack any of the relevant courses (or their equivalents) required for the M.Sc. must complete them in their Ph.D. M.Sc. students may be permitted to take up to two fourth-year half-courses and credit them towards the degree. Ph.D. students can credit only graduate courses.

When a student has covered material in a prior program, such as an M.Sc. in medical physics elsewhere, then the equivalent courses at Carleton are of course not required. The courses to be taken by a given student will be decided on in consultation with the student and the supervisor.

Listed for each course is the course number, the campus where taught and the course name. Carleton courses are numbered with the prefix “75” indicating Physics, followed by a 400-series number if fourth year, or either a 500- or 600- series number for graduate courses.

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<tr>
<th><strong>Specialization in Imaging</strong></th>
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<td><strong>Fall Term</strong></td>
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<td><strong>Winter Term</strong></td>
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<td>Carleton</td>
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<tr>
<td>Physics of Medical Imaging</td>
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¹Physical Applications of Fourier Analysis
²Ottawa HSC
³Half-course outside of medical physics
### Specialization in Therapy

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<td>Medical Physics Practicum</td>
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<td><strong>75.526</strong></td>
<td>Carleton</td>
<td>Medical Radiotherapy Physics</td>
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<td>75.528</td>
<td>Carleton</td>
<td>Radiation Protection</td>
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<tr>
<td><strong>Fall &amp; Winter</strong></td>
<td><strong>ANA 7301</strong></td>
<td>Ottawa</td>
<td>HSC² Anatomy</td>
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<tr>
<td>(both terms)</td>
<td><strong>PHS 5210</strong></td>
<td>Ottawa</td>
<td>HSC² Physiology</td>
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<tr>
<td><strong>Fall or Winter</strong></td>
<td><strong>75.5xx/6xx</strong></td>
<td>Carleton or Ottawa</td>
<td>Half-course outside of medical physics³</td>
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### Specialization in Biophysics

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<td>Carleton or Ottawa</td>
<td>Half-course outside of medical physics³</td>
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1 Prerequisite to 75.524; additional to degree if PhD  
2 HSC = Health Sciences Centre, Smyth Road  
3 Subject to approval. Permission may be given for 75.4xx if MSc  
4 In the Biophysics specialization, one of Radiobiology, Anatomy or Physiology must be taken.

### Course Descriptions

**75.523F--- Medical Radiation Physics** (½ course, Fall) Basic interaction of electromagnetic radiation with matter. Sources: x ray, accelerators, nuclear. Charged particle interaction mechanisms, stopping powers, kerma, dose. Introduction to dosimetry. Units, measurements, dosimetry devices.  
Lecturer: P.C. Johns

**75.524W--- Physics of Medical Imaging** (½ course, Winter) Outline of the principles of transmission x-ray imaging, computerized tomography, nuclear medicine, magnetic resonance imaging, and ultrasound. Physical descriptors of image quality, including contrast, resolution, signal-to-noise ratio, and modulation transfer function are covered and an introduction is given to image processing.  
Prerequisites: Medical Radiation Physics or equivalent and knowledge of Fourier optics at the senior undergraduate level.  

Prerequisite: Medical Radiation Physics or equivalent.  

Prerequisite: Medical Radiation Physics or equivalent must have been taken, or be taken concurrently.  
Lecturer: G.P. Raaphorst
OMPI Newsletter, June 1999

Prerequisite: Medical Radiation Physics or equivalent.
Lecturer: V. Elaguppillai

75.529F---Medical Physics Practicum (½ course, Fall) This course provides hands-on experience with current clinical medical imaging and cancer therapy equipment, and dosimetry and biophysics instrumentation. Experimental projects on medical imaging, radiotherapy, dosimetry, and biophysics, conducted at local clinics and NRC laboratories in Ottawa.
Prerequisites: Medical Radiation Physics or equivalent, plus, as appropriate to the majority of projects undertaken, one of Physics of Medical Imaging, Medical Radiotherapy Physics, or Radiobiology or other biophysics course.
Coordinator: B. J. Jarosz

The following life science courses are available at the University of Ottawa and are appropriate to medical physics graduate students:

ANA 7301---Anatomy for Medical Physics Graduate Students (½ course, extends through Fall and Winter) A basic course in anatomy for medical physics students utilizing the systemic approach to emphasize practical and clinical aspects of the gross structure of the human body. The course consists of lectures, laboratory demonstrations with dissected materials and a series of audio-visual presentations involving imaging techniques.

PHS 5210---Mammalian Physiology (full course, extends through Fall and Winter) A comprehensive study of mammalian physiology with an emphasis on regulating mechanisms. The course includes the biophysical basis of excitable tissues and the physiology of the central nervous system, blood and cardiovascular system, respiratory system, endocrine system, G.I. tract and renal physiology. It is assumed that students have a basic knowledge of chemistry, physics and biology.

In addition, the following physics half courses are particularly relevant:

Prerequisite: An ability to program in FORTRAN, C, or C++ and permission of the Department.
Lecturer: D. Karlen

Prerequisite: Physics 75.387; or permission.
Lecturer: P.C. Johns

Half-course outside of medical physics Also required is a graduate physics course outside of medical physics. Appropriate possibilities include nuclear, theoretical, quantum, particle, and solid-state physics. Selection is subject to the approval of the Academic Officer.

Giles Santyr, Academic Officer, OMPI
Students

Medical Physics Programme Graduate Students
Note: “Starting date” is the date first taking courses or commenced lab work, not registration date.

Ph.D. Students

Cron, Greg
Physics Department, Carleton University
1125 Colonel By Drive, Ottawa K1S 5B6
520-2600x1073 (voice) 520-4061 (fax) gcron@physics.carleton.ca (e-mail)
Starting date: 9/95, Supervisor: Santyr, Specialization: Imaging
Thesis topic: Quantitative dynamic MRI of the breast
[Registered at U. of Wisconsin at Madison]

Leclair, Robert
Physics Department, Carleton University
1125 Colonel By Drive, Ottawa K1S 5B6
520-2600x1854 (voice) 520-4061 (fax) robert@physics.carleton.ca (e-mail)
Starting date: 9/94, Supervisor: Johns, Specialization: Imaging
Thesis topic: X-ray imaging using scattered radiation

Niedbala, Malgorzata
Ottawa Regional Cancer Centre, Department of Medical Physics
501 Smyth Road, Ottawa, K1H 8L6
737-7700x6942 (voice) 247-3507 (fax) niedbala@physics.carleton.ca (e-mail)
Starting date: 1/99 [following completion of M.Sc. with G.P. Raaphorst]
Supervisor: Raaphorst, Specialization: Biophysics
Thesis topic: Biophysics of radiation damage and repair

MacPherson, Miller
Ionizing Radiation Standards, Institute for National Measurement Standards
National Research Council of Canada, Ottawa K1A 0R6
993-2197 (voice) 952-9865 (fax) mmacpher@irs.phy.nrc.ca (e-mail)
Starting date: 2/93, Supervisor: Ross, Specialization: Therapy
Date of Ph.D. defence: July 20, 1998
Thesis topic: Measurement of electron stopping powers

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Ionizing Radiation Standards, Institute for National Measurement Standards
National Research Council of Canada, Ottawa K1A 0R6
993-2197 (voice) 952-9865 (fax) dbagheri@irs.phy.nrc.ca (e-mail)
Starting date: 9/93, Supervisor: Rogers, Specialization: Therapy
Date of Ph.D. defence: January 8, 1999
Thesis topic: OMEGA (online Monte Carlo radiotherapy planning)

Zhang, Geoffrey
Ionizing Radiation Standards, Institute for National Measurement Standards
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993-2197 (voice) 952-9865 (fax) gzhang@irs.phy.nrc.ca (e-mail)
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Date of Ph.D. defence: September 3, 1998
Thesis topic: OMEGA (online Monte Carlo radiotherapy planning)

M.Sc. Students

Gauthier, Yvan
MRI Unit, Department of Radiology, Ottawa Hospital, General Site
501 Smyth Road, Ottawa K1H 8L6
737-8476 (voice) 737-8611 (fax) ygauthie@physics.carleton.ca (e-mail)
Starting date: 1/98, Supervisor: Cameron, Specialization: Imaging
Thesis topic: MRI measurement of water diffusion.
Graduate Student Theses Completed in '98-99

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Undergraduate Honours Physics Project Completed in ‘98-99

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<tr>
<td>Charles, Kevin</td>
<td>75.499</td>
<td>&quot;A temperature controller for measurement of transverse relaxation times in BANG dosimeter gels” Supervisor: Giles Santyr.</td>
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Past Student Graduates

Below are listed the current positions held by graduates from the Carleton Physics program in Medical Physics.

BSS Rao MSc 1970
Holo Devnani MSc 1971
Alan Mortimer MSc 1974 Scientist, Canadian Space Agency
Donald Richardson MSc 1975
Mike White MSc 1977 Ontario Hydro
Michael Ebifegha MSc 1980
Kulvir Kapoor PhD 1981 Ontario Hydro
Hripsime Shahbazian MSc 1984
Bruce Faddegon PhD 1990 Radiotherapy physicist, Toronto-Sunnybrook Regional Cancer Centre
Elias Zakhour MSc 1991 Was Physics assistant, Ottawa Regional Cancer Centre. Position unknown.
Reza Dokht MSc 1991 sessional instructor in medical physics, Tehran
Julia Older MSc 1991 (BSc, 1989) Physics assistant, Ottawa Regional Cancer Centre
Andrew Weber MSc 1991 (BSc, 1988) telecommunications industry
David Wilkins PhD 1993 Radiotherapy physicist, Ottawa Regional Cancer Centre
Ted Lawrence MSc 1993 Radiotherapy physicist, Sydney, N.S.
Dennis Heller PhD 1993 Faculty of Medicine, Univ. of Cincinnati
George Ding PhD 1995 Radiotherapy physicist, Vancouver
Doru Kaytar MSc 1995 software industry
Dennis Akyürekli PhD 1995 (MSc, 1988, BSc, 1985) Radiotherapy physicist, Kingston Regional Cancer Centre
Bilal Shahine MSc 1995 PhD student at Univ. British Columbia
Ria Corsten MSc 1995 Radiotherapy physicist, St. John’s, Nfld.
Julia Wallace PhD 1996 Research Associate with Prof. Giles Santyr (CMRF)
Patrick Rapley PhD 1996 Radiotherapy physicist, Kelowna, B.C.
Cathy MacGillivray MSc 1996 Trainee in clinical medical physics, Winnipeg
Ruth Brown PhD 1996 Post-doc in biophysics, Health Canada
Larry Gates PhD 1997 Post-doc in clinical mri, Halifax
David Gobbi   MSc  1997  PhD student at Univ. Western Ontario
Mazen Soubra   PhD  1997  Radiotherapy physicist, upstate New York
Kevin Lenton   PhD  1998  Post-doc in biophysics at Univ. Sherbrooke
Sheri Boyd   MSc  1998  MD student at McMaster University
Miller MacPherson  PhD  1998  Radiotherapy Physicist, Ottawa Regional Cancer Center
Geoff Zhang   PhD  1998  Physicist at JDS Fitel in Ottawa
Malgorzata Niedbala  MSc  1998  Currently a Ph.D. student in our program
D. Sheik-Bagheri   PhD  1999  Medical Physicist at Theratronics
Tanya Hewitt   MSc  1999  Research Assistant at the Ottawa Heart Institute

Scientific Societies of Relevance to Medical Physics

The following scientific societies are of interest to students and scientists in medical physics. For further information contact the individuals listed:

AAPM  American Association of Physicists in Medicine       Paul Johns, Dave Rogers
CAP     Canadian Association of Physicists               Bob Clarke, Paul Johns, Dave Rogers
COMP   Canadian Organization of Medical Physicists       Paul Johns, Lee Gerig, Ken Shortt
CRPA   Canadian Radiation Protection Association         Clive Greenstock, Dave Rogers
EMBS  Engineering in Medicine and Biology Society of the IEEE  Bog Jarosz
HPS     Health Physics Society                           Dave Rogers, Clive Greenstock
IRPS  International Radiation Physics Society            Paul Johns
RRS    Radiation Research Society                        Peter Raaphorst, Clive Greenstock
ISMRM  International Society for Magnetic Resonance in Medicine  Ian Cameron, Giles Santyr
CNS    Canadian Nuclear Society                           Clive Greenstock

OMPI Social Activities over the last year

Over the last year, in connection with the seminars, our institute has started to organize a limited number of social activities. The purpose is more informal get-togethers between members as well as students in connection with the professional and student seminars. A social activity usually consists of an outdoor sports or non-sports activity followed by dinner at a local restaurant or a BBQ. Over the last year the social activities included a soccer game, broomball and a visit to Theratronics in Kanata. Below are some nice memories from the broomball event.
Kudos

- OMPI member Clive Greenstock was appointed to the Editorial Board of the HPS journal Health Physics in January, 1998.
- OMPI student Gosia Niedbala is the proud chairperson of the new Carleton GASP – Graduate Association of Students in Physics, an organization to support graduate students at Carleton University. Support is provided in many ways, e.g. do comprehensive exam simulations, organize social events, etc.
- OMPI can be proud that several of its members were runners up for the Sylvia Fedoruk Prize for best Canadian paper in 1998 within the field of medical physics:
- OMPI member Jan Seuntjens and former OMPI member Chang-Ming (Charlie) Ma won a COMP poster award at the 1999 annual meeting in Sherbrooke, QC (June 16-19, 1999).

OMPI E-mail Bursters

E-mail sent to the following addresses is broadcast to all users on the respective lists by the e-mail burster at Carleton.

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## Member and Student Directory

### Members

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<th>Name</th>
<th>Telephone</th>
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### Students

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¹ Associate Member
² Registered at University of Wisconsin at Madison