

# MPORU NEWSLETTER

Medical Physics Organized Research Unit  
Physics Department, Carleton University

Editor Dave Rogers

Number 1, Sept 1989

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# 1 An Introduction to the Medical Physics Organized Research Unit

An area of growth in today's society is the application of high technology in medicine. It was recognized that Medical Physicists have a substantial role to play in this area and today there is an ever increasing shortage of Medical Physicists available to support development of high technology and its safety and quality-assured use in the Health Care Industry.

Several medical physicists in the Ottawa region realized that the Ottawa-Carleton region had a substantial human resource base in Medical Physics. People with expertise in Medical Physics could be found at the universities as well as in the hospitals, Cancer Centre, National Research Council, Health and Welfare and other institutions. With such a resource it required only organization and focus to bring this expertise together to deal with the issues of Medical Physics of today and of the future.

It was a consensus view of the group that Medical Physics indeed should be an area of concentration for training new graduate students. In this regard, Drs. G.P. Raaphorst and R.L. Clarke met with various individuals at the University and other institutions to form a Medical Physics interest group and a small sub-group called the Medical Physics Committee.

In a two year process, the Medical Physics Committee developed guidelines for an academic program in Medical Physics for the training of graduate students. During this period an academic curriculum in Medical Physics was also developed and is now in practice at Carleton University. In order to provide focus and direction to the Medical Physics program in the Ottawa-Carleton region, it was decided that it would be expedient to form some type of a Medical Physics organization. With the assistance of Carleton University it was decided that an organized research unit in Medical Physics might be the ideal solution. Steps were taken to evaluate this concept and after due consideration and discussion the members of the Medical Physics Interest Group voted that a Medical Physics Organized Research Unit should be formed.

A document of description and guidelines for the Medical Physics Organized Research Unit were drawn up. This document along with a letter of request for the formation of an organized research unit were sent to the Dean of Sciences at Carleton University. With the assistance of the Dean, this document was fine-tuned and is now in the process of being approved. A copy of this document which includes a list of the objectives of the MPORU is found elsewhere in the Newsletter.

The executive of the ORU consists of a director, a secretary, an academic officer and a student representative. The organizational and operational tasks of the Organized Research Unit are divided amongst the executive. The student representative deals with matters pertaining to the students role within the MPORU.

During the process of the development of the Medical Physics Interest Group, then the Medical Physics Committee and finally the Medical Physics Organized Research Unit, there has been extensive activity in the Medical Physics program as it developed. These are as follows.

1. The number of graduate students enrolled in Medical Physics has increased from 1 to 12 in a 3 1/2 year period.
2. Four to five research grants have been funded to members of the Medical Physics Community. These research grants are used to support Medical Physics research programs and Medical Physics graduate students.
3. A complete Medical Physics curriculum has been developed and is now being taught.
4. A Medical Physics Seminar Program has been developed for 1989-90.
5. Many strong research collaborations between various medical physicists within the group have been developed and are especially strongly supported by the work of graduate students.
6. Many of the member institutions such as the Ottawa Regional Cancer Centre, the National Research Council, Health and Welfare Canada and the two universities have made laboratories available for research in Medical Physics.
7. Several of the graduate students within the program have won awards and fellowships to support their research programs. With these accomplishments and many more to come in the future, the Medical Physics program is moving forward rapidly and is looking for an exciting future of research and academia. The members of the Medical Physics ORU are committed to providing excellence in graduate student training and research and offer a wide variety of research facilities which can provide an exciting array of choices for present and future graduate students in the program. In addition, the participation of graduate students in collaborative efforts in research within the programs of the MPORU will strengthen the research effort and provide significant benefit to the institutions from which employees are involved with supervising graduate students. There are several good examples of graduate students forming the basis for strong collaborative research efforts among two or three institutions.

As the MPORU we are at the beginning of a long and exciting journey. At the end of the journey the treasure will be a new and strong generation of Medical Physicists to make significant contributions to the Canadian Health Care Industry. Along the journey there will be many challenges and excitement to keep the activity and interest of the MPORU at a high and exciting level.

Peter Raaphorst

## 2 Proposal for an Organized Research Unit on Medical Physics

### 1. Overview

This document is intended to address the requirements stated in the document "Guidelines for the Formation of Research Collectives (Organized Research Units)". It proposes the formation at Carleton of an ORU on Medical Physics, drawing on individuals from organizations within Carleton and external to it. For the present these will be:

Physics Department, Carleton University,  
Department of Physics, University of Ottawa (Note 1),  
The Ottawa Clinic of the Ontario Cancer Treatment & Research Found. (Note 2),  
Health and Welfare Canada, and  
The Physics Division of the National Research Council (Note 3)

The document deals with the objectives of the ORU, its membership criteria, its management structures, and its Annual Report. The impetus for setting up the ORU is given.

### 2. MPORU Objectives

There is, in the Ottawa area, a significant number of research workers in several of the various fields known as medical physics, specifically in therapy, imaging, radiation biophysics, and radiation standards. Important developments in these areas hold promise for improvements in the diagnosis and understanding of disease and applications of high technology to patient care. It has also become apparent on a national, and perhaps world scale, that a shortage of scientifically trained and clinically skilled physicists is developing. Recent meetings of area persons have led to the formation of a precursor to the proposed MPORU which has identified areas of common interest.

The objectives of the MPORU will be:

- 2.1 To promote basic and applied research in those fields of medical physics in which there is local strength, in conformity with the research objectives of the institutions involved.
- 2.2 To advise the Carleton University Physics Department and OCIP on matters of Medical Physics.
- 2.3 To develop collaborative research activity in these fields.
- 2.4 To promote graduate studies in medical physics.
- 2.5 To facilitate graduate student placement with a supervisor who is a member of the ORU.

- 2.6 To develop laboratory facilities for medical physics.
- 2.7 To encourage funding from government and from private agencies.
- 2.8 To organize seminars, meetings and other forms of communication among the members.

It is the belief of those engaged in research in medical physics that the formation of MPORU will help substantially in the search for research funding in this field. Funding to support research and graduate students has not been easy to find in competition with other more readily recognized fields in medicine and physics.

### 3. MPORU Membership

The membership will consist of individual scientists whose activities and expertise would further the objectives of the MPORU. Membership will be by invitation of the Executive and will be restricted to those active in the Medical Physics field (via research, graduate student supervision, or substantial participation in the teaching of the graduate courses).

The initial membership will be:

R.L. Clarke	Carleton
P. Dvorak	H&W
R. Hodgson	U of O
P.C. Johns	Carleton
D.A. Morison	H&W
G.P. Raaphorst	OCTRF
D.W.O. Rogers	NRC

Other possible members will be approached.

### 4. MPORU Management Structure

It is understood that MPORU will report through the Chairman of the Carleton Physics Department to the Dean of the Faculty of Science of Carleton University.

#### 4.1 Executive

The unit will elect from its members an Executive consisting of three officers:

- 1. A Director to oversee and lead the operation of the ORU, guide the relations of MPORU and the institutions from which its members come, coordinate the scientific efforts of the members, and produce the Annual Report.
- 2. A Secretary to record the proceedings of the ORU, coordinate matters of public relations and publicity, to produce a newsletter, and to assist in the organization of MPORU seminars and workshops.
- 3. An Academic Officer to coordinate graduate student activities with the appropriate university authorities. He will also undertake liaison with the student representative, to ensure that matters of



direct concern to the graduate students will be brought to the attention of the Executive, with invitation of the student representative to appropriate meetings.

The officers will be elected for a period of two years, renewable, with elections to take place in December of alternate years. As far as possible the terms of the officers should be staggered. The Executive and MPORU membership are expected to meet regularly.

#### 4.2 Advisory Board

Because of the commitment of the MPORU to collaborative research and education between the Universities and local institutions, it is proposed that an Advisory Board be established as soon as possible after the formation of the ORU. The principal function of the Board will be to review the activities and research and educational activities of the ORU and make recommendations on its future directions.

The proposed composition of the Board is as follows:

Director of the MPORU,  
Director of OCIP,  
One representative from OCTRF,  
One representative from H&W,  
One representative from NRC.

The Advisory Board will be chaired by the Director of the MPORU.

#### 5. Annual Report

The MPORU will publish an annual report, in conformity with the requirements of the Universities, to publicize its strengths and accomplishments. The report will cover research and graduate studies, with descriptions of the activities of its members and the laboratory facilities available, and a listing of publications.

#### 6. Present Status

The MPORU is being founded by the Medical Physics Committee (Note 4) acting on behalf of an informal group of physicists interested in the development of medical physics in the Ottawa area. Thus, a large fraction of the medical physicists in the area are represented, either directly or indirectly. The Physics Department at Carleton has for several years accepted graduate students in medical physics. Now, acting on the advice and detailed suggestions of the MPC, it is in the process of setting up programs in medical physics as a formal part of its calendar offerings. The opportunities thus presented to graduate students will, of course, be available to students at the University of Ottawa. At present there are about eight students in the program at both MSc and PhD levels. The laboratory facilities at which these students are educated are at present those of Carleton, OCTRF and NRC. The funds directly associated with graduate student support are more than \$100,000. Facilities for research in x-ray and ultrasound imaging are coming on line.

7. Notes:

Note 1 - Graduate studies in physics at the two universities are combined under the Ottawa Carleton Institute for Physics.

Note 2 - The OCTRF has cancer clinics at both the Ottawa Civic Hospital and the Ottawa General Hospital. A single combined physics department serves both sites.

Note 3 - At present there is one Carleton physics graduate student in the Physics Division of NRC, and one in the Biology Division. Both are working on medical physics projects. One scientist from the Medical Engineering Section of the Division of Electrical Engineering is also a founding member of the informal group of physicists who wish to see the ORU developed.

Note 4 - The Medical Physics Committee was set up by the the informal group referred to above, with a mandate to develop graduate studies in medical physics, and to investigate the creation of a formal structure for medical physics activities. It is as a result of this mandate that the present request for an Organized Research Unit is being presented.

### 3 Information on Student Placement and Supervision

Within the context of the practices of the Carleton Faculty of Graduate Studies and Research, the Ottawa-Carleton Institute of Physics, and the Carleton Physics Dept, the MPORU has adopted the following policy for the placement of graduate students:

1. There must be a mutually agreeable match between student and supervisor before a student is accepted.
- 2.(a) Some graduate students will be attracted to the medical physics program by the reputation of a particular medical physicist, and will make a direct agreement with that person to become their student.
- (b) When other students apply, information on the student's academic history and areas of interest will be made known to prospective supervisors, should the student be considered promising. Information on the medical physics program and all supervisors in MPORU will be given to the student, with indication of where there are vacancies for a student.
3. Acceptance on the part of the supervisor implies financial support of the student as per Physics Dept policy.
4. The student will be free to change supervisors once in the Physics Dept, subject to the mutual agreement of the 2nd supervisor.

Students are financially supported by the following means:

- the best students win their own NSERC, MRC, NCI, OGS scholarships. Foreign students are not eligible for all of these.
- most students work as Teaching Assistants.  
In 1988/89, a full TA (10 hours/week for 2 terms) paid \$ 5366.
- there is a small amount of scholarship money which is spread fairly evenly amongst the students by the Graduate Studies Coordinator of the Physics Dept. This amounts to about \$1000 to \$2000/year per student.
- the balance of the needed support is usually paid from the supervisor's research grant.

The Physics Dept aims to ensure that all students obtain at least \$11,000/year, with PhD students getting somewhat more. For students who do not win their own outside scholarship but do have a TA, the required support from the supervisor's research grant ranges from \$4,000 to \$9,000/year.

Current policy of the Physics Dept and of the Faculty of Grad Studies & Research for academic standing of graduate students is as follows:

MSc Program: B- or better must be achieved in all courses counted towards the degree. Hence courses in which a grade of C+ or less is achieved must be replaced (repeat the course, or take another). Students with an average below B- after two terms will be required to withdraw.



PhD Program: B- or better must be achieved in all courses counted towards the degree. Student progress is periodically evaluated by the Dept and must be satisfactory for the student to continue.

In order to qualify for a TA position, usually the student must enter the program with an average of A- or better.

Paul Johns  
Academic Officer, MPORU

25 Aug 1989.

## 4 Information on Fourth-Year Undergrad Student Projects

1 Aug 1989

All 4th year students do an experimental or theoretical project oriented towards research under the guidance of a supervisor at Carleton or the U of Ottawa. A written progress report must be prepared by the student at the midpoint of the project, and a written report is submitted at the end of term. In addition, an oral presentation is made at the end of term to all interested members of the Physics Dept, and is graded by the faculty members.

Most students do a full-year project (course number 75.499). Some students, especially those from the U of Ottawa, do a half-year project (75.497 for fall term, 75.498 for winter term).

The supervisor must supply the necessary lab equipment etc but has no other financial responsibility. One may apply in advance for Physics Dept funding for equipment out of a bulk fund provided by the Dean of Science for instructional equipment. Such equipment remains the property of the University.

A list of possible projects and supervisors is maintained in the Physics Dept by the Fourth-Year Project Coordinator, currently Lazer Resnick. Project descriptions usually give the general area of research only. ORU members interested in supervising a 4th year project should submit a short description (2 or 3 sentences is sufficient) to either Prof Resnick or to myself.

Paul Johns  
Academic Officer, MPORU

## 5 Seminar Series

### 5.1 MPORU Seminars

One of the main vehicles of the MPORU for developing and maintaining contacts is through a seminar series in which all the members will be asked to make a presentation, along with the graduate students in Medical Physics.

Seminars will take place at 3:30 pm on the second Wednesday of each month. They will be held in Rm 252 of the Herzberg Building at Carleton University. Donuts and coffee will be available in the seminar room prior to the meeting.

After a successful first meeting on Sept 13, the second meeting will be held on Wednesday, Oct 11. The format has changed slightly and will consist of a 20 min talk by a graduate student followed by a 40 min talk by a staff member plus question periods. A strict chairman will ensure everyone can leave by 5 pm. On Oct 11, the speakers are Bruce Faddegon and Peter Raaphorst.

### 5.2 Carleton University Physics Dept Seminars

Carleton University Physics Department runs a regular seminar series on Monday afternoons at 3:30 in Rm 252 of the Herzberg Building. These are often of interest to members of the MPORU. The following seminars will be of interest.

Oct 23, Jerry Battista will speak on Radiotherapy Treatment Planning

Nov 13, Mark Henkleman will speak on Magnetic Resonance Imaging

Oct 16, Alan Madej of NRC will speak on ion traps for frequency/time standards.

### 5.3 IRS Journal Club/ Seminar Series

The Ionizing Radiation Standards section of NRC holds a quasi-regular Journal Club/ Informal Seminar Series on alternate Monday mornings in the coffee area of M-35 at NRC Montreal Rd. Everyone is welcome to come but should check final times and topics with Alex Bielajew (993-2715). The current schedule is:

SPEAKER	DATE	TOPIC
1) Dallas Santry	Oct 16, 1989	Journal Review: <i>The Radon Problem</i> Radiat. Phys. Chem. 34(1989)251.
2) Norman Klassen	Oct 30, 1989	??
3) Alex Bielajew	Tues, Nov 14, 1989	??
4) Dave Rogers	Nov 27, 1989	??
5) Bruce Faddegon	Dec 11, 1989	??
6) Carl Ross	Jan 8, 1990	??
7) Len van der Zwan	Jan 22, 1990	??
8) Ken Shortt	Feb 5, 1990	??
9) Klaus Geiger	Feb 19, 1990	??

## 6 Membership Directory of the MPORU

Name	Telephone (Fax)	e-mail	Address
Alex Bielajew	993-2197 (954-7708)	BLIF at NRCVM01	Division of Physics N.R.C. Ottawa, K1A 0R6
Stephen Bly	954-0308 (957-2486)		Acoustics Unit Tunney's Pasture Ottawa, K1A 0L2
Robert Clarke			on sabbatical
Joanna Cygler	725-6267 (725-6320)		Ottawa Regional Cancer Centre Department of Medical Physics Civic Division 190 Melrose Avenue Ottawa, K1Y 4K7
Pavel Dvorak	954-0319 (952-7767)		X-Ray Section, Room 257A Health Protection Building Tunney's Pasture Ottawa, K1A 0L2
Lee Gerig	737-6862		Ottawa Regional Cancer Centre General Division 501 Smyth Road Ottawa, K1H 8L6
Clive Greenstock	584-3311 ext 6053 (589-2039)	05011 at AECLRC	Radiation Biology Branch Atomic Energy of Canada Ltd. Chalk River, Ontario K0J 1J0
Richard Hodgson	564-8283 (564-5014)	RJHSJ at UOTTAWA	Physics Department University of Ottawa Ottawa K1N 6N5
Boguslaw Jarosz	788-4318 (788-4389)	Bo Jarosz at Carleton.Ca	Carleton University Physics Department Colonel By Drive Ottawa, K1S 5B6
Paul Johns	788-4317 (788-4389)	JOHNS at NRCHEP.NRC.CA	Physics Department Carleton University Colonel By Drive Ottawa, K1S 5B6

<b>Name</b>	<b>Telephone (Fax)</b>	<b>e-mail</b>	<b>Address</b>
Norman Klassen	993-2715 (954-7708)	KLASSEN at NRCVM01	Division of Physics,Bldg M-35 N.R.C. Ottawa, K1A 0R6
Gary Kramer	954-6668		Bureau of Radiation and Medical Devices 775 Brookfield Road Ottawa, K1A 1C1
Deirdre Morison	954-0307 (952-7767)		Department of National Health and Welfare Rm 66, Health Protection Bldg Tunney's Pasture Ottawa, K1A 0L2
Alan Mortimer	993-1609		Div. of Electrical Engineering NRC Montreal Rd, K1A 0R6
Peter Raaphorst	725-6228		Ottawa Regional Cancer Centre 190 Melrose Avenue Ottawa, K1Y 4K7
Dave Rogers	993-2715 (954-7708)	IRS @NRCVM01	Division of Physics,Bldg M-35 N.R.C. Ottawa, K1A 0R6
Carl Ross	993-9352 (954-7708)		Division of Physics,Bldg M-35 N.R.C. Ottawa, K1A 0R6
John Saunders	990-0889		Biological Sciences NRC
Ken Shortt	993-2715 (954-7708)	IRS at NRCVM01	Division of Physics,Bldg M-35 N.R.C. Ottawa, K1A 0R6
Ian Smith	990-0884		Biological Sciences NRC

## 7 Graduate Courses in Medical Physics at Carleton University

Within the Physics Department, there are three medical physics courses which are being taught this year. Two of them are not yet in the calander (viz 75.523 and 75.524) but are being taught under the directed-studies course designation 75.591 in 1989/90. They will be in the calander next year along with a course in Radiation Protection Physics which will be taught next year.

### Physics 75.523 F1

#### Medical Radiation Physics

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.

Prerequisite: Permission of the instructor.

### Physics 75.524 W1 (PHY 5112)

#### Physics of Medical Imaging

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: Physics 75.523 or equivalent, and one of Physics 75.424 or 75.427 or equivalent.

### Physics 75.526 W1 Medical Radlotherapy Physics

Terminology and related physics concepts. Bragg-Gray, Spencer - Attix cavity theories, Fano's theorem. Dosimetry protocols, dose distribution calculations. Radiotherapy devices, hyperthermia.

Prerequisite: Physics 75.523 or equivalent.



## 8 Graduate Students Enrolled in the Medical Physics Program

### GRADUATE STUDENTS IN MEDICAL PHYSICS

25 Aug 1989.

<u>STUDENT</u>	<u>YEAR</u>	<u>PROG</u>	<u>SUPERVISOR</u>	<u>SPECIALIZATION</u>
Faddegon, Bruce	1986	PhD	Rogers,	Therapy
Wilkins, David	1986	PhD	Raaphorst	Biophysics
Heller, Dennis	1988	PhD	Raaphorst	Biophysics
Soubra, Mazen	1988 P.T.	PhD	Gerig	Therapy
Akyurekli, Dennis	1/89	PhD	Gerig	Therapy
Rapley, Patrick	9/89	PhD	Saunders	Imaging
Wallace, Julia	9/89	PhD	Raaphorst /Saunders	Biophysics/Imaging
Dohkt, Reza	1987 P.T.	MSc	Clarke	Imaging
Weber, Andrew	1988	MSc	Gerig	Therapy
Chaudhary, Vikas	1988	MSc	Gupta/Johns ( McGill/NRC )	Biophysics
Zakhour, Elias	1988	MSc	Raaphorst	Therapy
Akyuz, Bunyamin	1989	MSc	Johns	Imaging
Older, Julia	9/89	MSc	Johns	Imaging

## 9 LOGO Contest

The newsletter and the MPORU need a logo. Fame, prestige and the appreciation of all your MPORU colleagues will be yours if you submit the winning proposal for a logo which could be used on letterhead, the newsletter and seminar notices for the MPORU. Submissions to Paul Johns by Oct 10, 1989.

## 10 Kudos for Members of the MPORU

The Editor knows of several awards which have been received by members of the MPORU over the last few months. He would appreciate being informed of any future such awards to be included in future Newsletters.

Norman Klassen was made a Fellow of the Chemical Institute of Canada.

Bruce Faddegon took second place in the Young Investigators Symposium at the Annual Meeting of the American Association of Physicists in Medicine held in Memphis for his talk entitled *Absolute Bremsstrahlung Cross Sections at  $0^\circ$  for 10 to 30 MeV Electrons on Thick Targets of Al and Pb*. This puts him in the company of other well known Canadian medical physicists such as Paul Johns who took second place in 1984 and Rock Mackie who won in 1983.

The paper entitled *Generation of photon energy deposition kernels using the EGS Monte Carlo code* won the 1988 Sylvia Fedoruk Prize in Medical Physics which is awarded annually for the "best" paper in medical physics published by a Canadian group. Alex Bielajew attended the annual meeting of the Division of Medical and Biological Physics of the CAP in London to receive the award on behalf of the four authors of the paper (T.R. Mackie, A.F. Bielajew, D.W.O. Rogers and J.J. Battista) which was published in *Physics in Medicine and Biology* **33** (1988) 1-20.

## 11 Upcoming Courses at NRC

The Ionizing Radiation Standards section at NRC would like to make a preliminary announcement of two courses it will be presenting in 1990. The first will be a 3-day course in February on *The Fundamentals of Radiation Dosimetry, Radiation Standards and Dosimetry Protocols*. The second will be a 4-day course on the *Use of EGS4 for Electron Monte Carlo Transport Calculations* and will include hands-on laboratory sessions.

## 12 CVs of Members of the MPORU

### Alex F. Bielajew

**POSITION:** Research Officer, Division of Physics, National Research Council of Canada, Ottawa K1A 0R6  
Tel: (613)993-2197 FAX: (613)954-7708 e-mail: BLIF @ NRCVM01.BITNET

**EDUCATION:** Stanford University, California, Ph.D. (1982) in Theoretical Physics

**RESEARCH AND PROFESSIONAL EXPERIENCE:**

- Employed in the Ionizing Radiation Standards Section of the Basic Standards Laboratory as a radiation transport and dosimetry theorist.
- Development of Monte Carlo simulation theory for electron-photon transport in the energy range 10 keV-50 MeV. In particular, extending and improving the lower energy range.
- Development of the EGS4 (Electron Gamma Shower) Monte Carlo computer code system as well as "user" codes and geometry packages for EGS4 code in VAX, IBM 3090, FPS-264, IBM/PC, Sun and Silicon Graphics environments.
- Development of fundamental dosimetry theory, Monte Carlo methods for radiation dosimetry and radiotherapy applications, and integration of Monte Carlo methods into new treatment planning algorithms.
- Development of saturation theory for ion chambers in continuous and pulsed beams.

**AWARDS:**

- Sylvia Fedoruk Prize in Medical Physics. CAP(DBMP) London, Ontario, 1989.
- Farrington Daniels Award. AAPM, Seattle 1985.

**SAMPLING OF PUBLICATIONS:**

1. "Theoretical and experimental investigation of dose enhancement due to charge storage in electron irradiated phantoms" *Med. Phys.* 11(1984)814.
2. "Calculated buildup curves for photons with energies up to  $^{60}\text{Co}$ " *Med. Phys.* 12(1985)738.
3. "Ion chamber response and  $A_{\text{wall}}$  correction factors in a  $^{60}\text{Co}$  beam by Monte Carlo simulation" *PMB* 30(1985)429.
4. "The Monte Carlo simulation of ion chamber response to  $^{60}\text{Co}$ —resolution of anomalies associated with interfaces" *PMB* 30(1985)419.
5. "The effect of free electrons on ionization chamber saturation curves" *Med. Phys.* 12(1985)197.
6. "Energy-loss straggling in electron Monte Carlo transport" in "Transactions of the American Nuclear Society", 52, American Nuclear Society Press, 1986, 380-2.
7. "Ionization cavity theory—a formal derivation of perturbation factors for thick-walled ion chambers in photon beams" *PMB* 31(1986)161.
8. "Electron beam dose distributions near small inhomogeneities" *PMB* 31(1986)235.
9. "The dependence of mass energy absorption coefficient ratios on beam size and depth in a phantom" *Med. Phys.* 13(1986)496.
10. "Differences in electron depth-dose curves calculated with EGS and ETRAN and improved energy-range relationships" *Med. Phys.* 13(1986)687.
11. "PRESTA—the "Parameter Reduced Electron-Step Transport Algorithm" for electron Monte Carlo transport" *NIM B* 18(1987)165.
12. "Generation of photon dose spread arrays using the EGS Monte Carlo code" *PMB* 33(1988)1.
13. Six Chapters:
  - "Electron step-size artefacts and PRESTA"
  - "20 MeV electrons on a slab of water"
  - "Experimental benchmarks of EGS"
  - "A comparison of EGS and ETRAN"
  - "Variance-reduction techniques"
  - "Electron transport in  $\vec{E}$  and  $\vec{B}$  fields"
 in "Monte Carlo Transport of Electrons and Photons", Plenum Press, New York, 1989.
14. "Monte Carlo techniques of electron and photon transport for radiation dosimetry, Vol.III" in "The Dosimetry of Ionizing Radiation", Academic Press, 1990, (in press).

**UNPUBLISHED NRCC REPORTS:**

1. "Use of ICRU-37/NBS Radiative Stopping Powers in the EGS4 System" PIRS-0177, 1989.
2. "Use of ICRU-37/NBS Collision Stopping Powers in the EGS4 System" PIRS-0173, 1989.
3. "Photoelectron angle selection on the EGS code system" PIRS-0058, 1986.
4. "Calculation of the contamination of the  $^{60}\text{Co}$  beam from an AECL therapy source" PXNR-2710, 1985.
5. "The use of EGS for Monte Carlo calculations in medical physics" PXNR-2692, 1984.

## Stephen Howard Perry Bly

Phone: 954-0308

Mail: Health Protection Bldg. Rm. 66, Tunney's Pasture, Ottawa, Ont.  
K1A 0L2

FAX: 957-2486

Position: Physicist, Acoustics Unit, Bureau of Radiation and Medical  
Devices, Health and Welfare Canada.

Research Interests: Development and characterization of  
instrumentation for ultrasonic exposure measurements and dosimetry.

Potential Research Projects for Graduate Students (beginning September  
1990):

(i) Measurement of temperature rise in tissue mimicking phantoms for  
diagnostic pulses and beams as a function of total power.

(ii) Investigation of potential for diagnostic ultrasound beams to  
accelerate blood clotting at high power.

Current Professional Appointments:

(i) Member Working Group 8 of Technical Committee 87 Ultrasonics of the  
International Electrotechnical Commission.

(ii) Liaison Member of the Bioeffects Committee of the American  
Institute for Ultrasound in Medicine.

Past Education: National Cancer Institute Postdoctoral Fellowship held  
at the Ultrasonics Group at the Ontario Cancer Institute under Dr.  
John Hunt (1982 - 1984). Ph. D. in Chemistry Department of the  
University of Toronto under Dr. John Polanyi. "Studies in Electronic  
Chemiluminescence" (1976 - 1982) supported by NSERC Scholarship and  
University of Toronto Open Scholarship. B. Sc. in Chemical Physics at  
the University of Toronto (1972 - 1976).

Typical Publications:

1. Quantitative contrast measurements in B-mode images: comparison  
between experiment and theory. S.H.P. Bly, D. Lee-Chahal, D.R. Foster,  
M.S. Patterson, F.S. Foster and J.W. Hunt. J. Ultrasound in Medicine  
and Biology, Vol. 12, pp. 197 - 208, 1986.

2. A portable ultrasonic power meter for routine calibration of  
ultrasonic therapy devices. R.G. Hussey and S.H.P. Bly. Journal of  
Clinical Engineering. Vol. 13, pp. 109 - 113, 1988.

3. Sensitivity of effective radiating area measurement for therapeutic  
ultrasound transducers to variations in hydrophone scanning technique.  
Health Physics, Vol. 57, 1989 (in press).

## Robert L. Clarke

### Education:

University of Alberta, B.Sc., Physics 1943  
 McGill University, Ph.D., Nuclear Physics, 1948

### Employment:

1943 - 1945 National Research Council of Canada  
 1948 - 1968 Atomic Energy of Canada, Chalk River, Ont  
 1962 - 1963 Rutherford Laboratory, Harwell, U.K.  
 1968 - 1987 Carleton University, Ottawa  
 1987- Retired, Adjunct Professor, Carleton University

### Visiting Positions at Royal Marsden Hospital, Sutton Surrey, U.K.

1978 - 1979, 1980 (summer), 1982 (brief), 1985 (summer)  
 1986 (1/2 year), 1989 (1/2 year)

### Research Interests:

Optics  
 Fast neutron physics, nuclear reactions, reactor physics  
 Polarised proton scattering  
 Gamma ray imaging  
 Ultrasound tissue characterisation, imaging, hyperthermia,  
 high intensity effects

### Teaching:

Nuclear physics for reactor physicists (A.E.C.L.)  
 Elementary physics, first and second year  
 Reactor physics, nuclear physics  
 Advanced physical optics, sensing and imaging

### Other:

Chairman, Physics Department (1972 - 78)  
 Carleton Senate, etc.  
 Carleton Board of Governors  
 C.A.P.: D.M.B.P., Editor Physics in Canada (1975 - 78),  
 Hon Sec-Treas (1987 -89)  
 Chairman Local Committee, Congress 1972  
 I.O.M.P.: Chairman Local Committee, Congress 1976  
 I.U.P.E.S.M. vice Sec.Gen. 1985-1988  
 Sec. General 1988 - ( to 1991)



## Joanna Cygler

- ADDRESS:** Ottawa Regional Cancer Centre,  
Department of Medical Physics,  
Civic Division,  
190 Melrose Avenue,  
Ottawa, Ontario K1Y 4K7  
**TEL:** (613) 725-6267      **FAX:** (613) 725-6320
- CURRENT POSITION:** Medical Physicist
- IN SERVICE AREA DUTIES INCLUDE:** Radiation dosimetry in external beam therapy and brachytherapy, supervision of treatment planning procedures, Quality assurance of treatment machines and other clinical equipment.
- TEACHING RESPONSIBILITIES:** Coordination of educational activities of the Ottawa Regional Cancer Centre Medical Physics Department, coordination of the Medical Radiotherapy Physics course (75.526) at Carleton University, teaching of residents and technologists, teaching of graduate students and medical physics residents
- RESEARCH INTERESTS:** Electron Beam Dosimetry  
Radiobiology  
Brachytherapy
- EDUCATION:** MSc. in experimental physics, 1972, Ph.D. in radiation chemistry, 1978.
- RECENT PUBLICATIONS:**
1. Cygler, J., Klassen, N.V. and Teather, G.G.,  
Trapped Electrons in Tert-Butanol-Water glasses. *Rad. Phys. Chem.*, 27, 47, (1986)
  2. Cygler, J., Klassen, N.V. and Ross, C.K.,  
Pulse Radiolysis Studies of the Solvated Electron in Tertiary Butanol-Water Solutions  
*Can. J. Chem.*, 64, 1548 (1986)
  3. Cygler, J., Battista, J.J., Scrimger, J.W., Mah, E., Antolak, J.,  
Electron Dose Distributions in Experimental Phantoms: A Comparison with 2D Pencil Beam Calculations. *Phys. Med. Biol.*, 32, 1073 (1987)
  4. Bielajew, A.F., Rogers, D.W.O., Cygler, J., Battista, J.J.,  
"A Comparison of Electron Pencil Beam and Monte Carlo Computational Methods", in *Use of Computers in Radiation Therapy*. p. 65-68, North-Holland, 1987
  5. Cygler, J., Lavigne, B., Raaphorst, G.P.,  
Modification of the Selectron Standard Applicator for the Gynecological Treatments  
*British Journal of Radiology*. 60, 1238, (1987)
  6. Cygler, J., Copeland, F.,  
Role of CT Scanning in Radiation Therapy with Electron Beam  
*Medical Dosimetry*. 13(2), 69, (1988)
  7. Cygler, J., Ross, J.,  
Electron Dose Distributions in an Anthropomorphic Phantom - Verification of Theraplan Treatment Planning Algorithm  
*Medical Dosimetry*. 13, 155, 1988
  8. Cygler, J., Szanto, J., Soubra, M., Rogers, D.W.O.  
"Effects of Gold and Silver Backings on the Dose Rate Around an 125I Seed"  
Submitted for publication.

## Pavel Dvorak

Telephone: 1-613-954-0319 (office)      1-613-226-4188 (home)  
Telefax: 1-613-952-7767

Address: X-Ray Section, Rm. 275A  
Health Protection Building  
Tunney's Pasture  
OTTAWA, Ontario  
K1A 0L2

**Current Position:** Head, X-Ray Section, Bureau of Radiation and Medical Devices

**Research Interests:** X-ray doses in medical diagnostic procedures, risk/benefit evaluations, computer simulations of X-ray interactions; currently not able to supervise graduate students

**Current Professional Appointments:** Chairman, Canadian National Committee for IEC Subcommittees 62B and 62C; Chairman, CSA Technical Committee for Equipment in Radiology and Nuclear Medicine

**Past Jobs:** Assistant Professor, Dept. of Physics, Faculty of Technical and Nuclear Physics, Prague, Czechoslovakia (1960-69); Research Physicist, Picker X-Ray Mfg. Ltd., Bramalea, Ontario (1972-76)

**Education:** M.Sc., Experimental Nuclear Physics, Czech Technical University, Prague, Czechoslovakia, 1960

**Professional Affiliations:** Division of Medical and Biological Physics; Canadian Radiation Protection Association; Association of Professional Engineers of Ontario

No major publications (most of work done in industrial research and regulatory field); typical papers:

P. Dvorak, E. Kairiss: Bremsstrahlung Spectra from Diagnostic X-Ray Generators, CAP Congress 1973, Montreal, Quebec

P. Dvorak: A Comparison of Relative Effect on the Image Quality of the Object Motion and the Focal Spot Geometry, CAP Congress 1975, Toronto, Ontario

P. Dvorak, L. Szegedi and D.K. Friend: A Comparison of Integral Absorbed Dose in Panoramic and Conventional Dental X-Ray Examinations, Proc. HPS Fourteenth Mid-Year Topical Symposium, Hyannis, Mass. 1980

P. Dvorak et al: A Study of X-Ray Dose to Scoliosis Patients, Proc. 3rd SRP International Symposium, Inverness, Scotland, 1982

## Lee H. Gerig

- CONTACT:** Ottawa Regional Cancer Centre  
General Division  
501 Smyth Road  
Ottawa, Ontario K1H 8L6  
(613) 737-6862
- PRESENT POSITION:** Senior Physicist  
Head, Section of Clinical Physics  
Ontario Cancer Treatment and Research Foundation  
Ottawa Regional Cancer Centre
- Adjunct Professor  
Carleton University  
Department of Physics
- Lecturer, University of Ottawa  
Department of Radiology
- EDUCATION:** BSc. University of Western Ontario 1975  
Ph.D. University of New South Wales 1985
- AFFILIATION:** -Radiation Research Society  
-Canadian Association of Radiation Oncology  
-North American Hyperthermia Group
- TYPICAL PUBLICATIONS:** Intra Cranial Volume Response During the Treatment of Gliomas.  
M.D. Riding, L.H. Gerig, A. Girard, D. Stewart  
Proceedings of Symposium Neuroradiologium, June 1986
- Prognostic Significance of Endometrial Extension in Carcinoma of the Cervix.  
L. Grimard, P. Genest, A. Girard, L. Gerig, M. Prefontaine, P. Drouin, R.C. Nair  
Accepted in Gynecologic Oncology, 1987
- A Computerized Thermocouple Based Clinical Thermometry System.  
L. Gerig, C.E. Danjoux, G.P. Raaphorst, Z. Hauderowicz, S. Holford  
Endocurietherapy/Hyperthermia Oncology, an International Journal, 4:31-37, January 1988.
- Impact of Local Radiation in the Management of Salivary Gland Carcinomas.  
L.J. Eapen, L.H. Gerig, G.E. Catton, C.E. Danjoux, A. Girard  
Head & Neck Surgery - Mar/Apr:239-245, 1988.

## Clive Lewis Greenstock

Radiation Biology Branch, Atomic Energy of Can. Ltd., Chalk River, Ont.

KOJ 1J0 (613)584-3311, ext. 6053, FAX (613)589-2039, E-mail 05011 @ AECLRC

2. Research Officer. Twenty years experience in scientific research and development in accelerators and radiation sources, dosimetry and radiological protection, carcinogenesis and risk/benefit analysis, cancer diagnosis and treatment, radiobiology and radiation chemistry/physics, free radicals and chemical kinetics, chromatography, polarography, calorimetry, electrophoresis, spectroscopy (AA, absorbance, fluorescence, ESR & NMR), oncogenes, monoclonal antibodies, cell transformation and cancer screening. Graduate student projects to develop biological dosimeters of low-level damage by radiation and other environmental threats, to assess biophysical techniques for cancer screening, cancer proneness, radiosensitivity and early diagnosis of cancer, to implement strategies for radiation protection and cancer prevention, and to monitor conformational changes in DNA and cell membranes associated with cell growth and regulation, differentiation, and the induction of biochemical and immunological defences.
3. Councillor, Biophysical Society of Canada. Radiation Chemistry Data Center Advisory Committee, Notre Dame IN. Radiosensitizer/Radioprotector working group member, ROTG, US National Cancer Institute. Associate editor for Radiation Research 1977-81. Science in the Schools Programme and Speakers Bureau, AECL. International Cancer Research delegation to South Africa 1985.
4. National County Scholar 1957-60, Scientific Research Council grant 61-63, Canadian Cancer Research award 64-68, National Cancer Institute of Canada Fellow 69-70, LH Gray Memorial Trustee 73,77, Commission of the European Communities grantee 78, Radiation Research Society Travel awardee 79, International Union of Pure and Applied Biophysics awardee 81, Radiation Research Society Travel awardee 83, Heineman Foundation Fellow 83-84, Royal Society Commonwealth Research awardee 83-84, NATO Advanced Study Institute awardee 84, Canadian Cancer Society grantee 85, Presidents' Fund Medical Research Council of Canada 85, NSERC Industrial awardee 86, Elected Fellow of the Institute of Physics 86, International Union against Cancer Technology Transfer awardee 87.
5. Medical Physicist (60-61) Cardiff Radiotherapy Centre UK, Medical Physics Appointee (63) Ontario Cancer Institute, Radiological Physicist (63-64) National Physical Laboratory, Medical Biophysicist (70-88) Whiteshell Nuclear Research Establishment. B.Sc. hons. (Physics) (60) University of Leeds, M.Sc. (Medical Physics) (63) St. Bartholomew's Hospital Medical College, University of London, Ph.D. (Radiation Biophysics) (68) University of Toronto.
6. Fellow of the Institute of Physics (FInstP), Chartered Physicist (CPhys), American Association for Cancer Research, Association for the Advancement of Science in Canada, Association for Radiation Research, Biophysical Society of Canada, British Institute of Radiology, Chemical Institute of Canada, Canadian Association of Physicists, Institute of Physics, Radiation Research Society, Sigma Xi, Society for Free Radical Research.
7. Greenstock, C.L. Oxygen radicals and ions and their control in biology. In "Advances in Oxygen Radicals and Radioprotectors", eds. A. Breccia, C.L. Greenstock and M. Tamba, Lo Scarabeo, Bologna, 1984, pp 29-45.  
Greenstock, C.L. Free radical processes in radiation and chemical carcinogenesis in "Advances in Radiation Biology, Vol. 11", eds. J.T. Lett and H.I. Adler, Academic Press, New York, 1984, pp 269-294.  
Greenstock, C.L. Oxy radicals and the radiobiological oxygen effect, *Israel J. Chem.*, 24, 1-10, 1984.  
Greenstock, C.L. and Whitehouse, R.P. The effect of additives on irradiated and autoxidized phospholipids. *Life Chem. Reports*, 3, 49-56, 1985.  
Greenstock, C.L. and Whitehouse, R.P. Radiosensitizers as probes of DNA damage and cell killing. *Int. J. Radiat. Biol.* 48, 701-710, 1985.  
Greenstock, C.L. Radiation-chemical aging, and induction and promotion of biological damage. In "Free Radicals, Aging and Degenerative Diseases", Alan R. Liss Inc., New York, 1986, pp 197-221.  
Greenstock, C.L. The Role of Free Radicals in Radiation Chemical Aging, *Progress in Reaction Kinetics*, Vol. 14, eds., K.R. Jennings and R.B. Cundall, Pergamon Press, Ltd., Oxford, 1986, pp 249-265.  
Greenstock, C.L., Jinot, C.P., Whitehouse, R.P. and Sargent, M.D. DNA Radiation damage and its modification by metallothionein. *Free Radical Res. Commun.* 2, 233-239, 1987.  
Buxton, G.V., Greenstock, C.L., Helman, W.P. and Ross, A.B. Critical review of rate constants for reactions of hydrated electrons, hydrogen atoms and hydroxyl radicals (OH/O<sup>-</sup>) in aqueous solution. *J. Phys. Chem. Ref. Data* 17, 513-886, 1987.  
Greenstock, C.L. Radiation Chemical Considerations for the Radioprotection of Cellular Targets. *Pharmacol. & Ther.* 39, 139-145, 1987.



## Richard J.W. Hodgson

Mailing address: Physics Department  
University of Ottawa  
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FAX (613) 564-5014  
e-mail: RJHSJ at UOTTAWA

**Current Position:** Associate Professor of Physics

**Research Interests:** Am currently interested in applications of inverse scattering methods; numerical methods; and quantum mechanics. To date no research has been done in medical physics, but I would like to study some applications of inverse theory in areas such as thermography, ultrasound, etc. Am planning to also work on the general problem of three-dimensional acoustic scattering. This latter problem aims at the determination of the shape of an acoustically soft object from a knowledge of the incident wave and the far-field pattern of the scattered wave.

**Employment history:** Associate professor of physics, University of Ottawa, 1973 – present

Assistant professor of physics, University of Ottawa, 1969 – 1973

Postdoctoral Fellow, University of Alberta, 1967- 1969

Received Ph.D. in Physics from University of Sydney, Australia, 1967

Received Honours B.Sc. in physics from the University of Alberta, 1963

**Publications:** to date all publications have been in the areas of nuclear physics, quantum mechanics, and inverse scattering theory.



## Boguslaw Jan Jarosz

**Carleton University, Department of Physics**  
**Colonel By Drive**  
**Ottawa, Ontario K1S 5B6**  
**Tel. (613) 788-4318, 788-4312**  
**Fax: Faculty of Science, (613) 788-4389**  
**E-mail: Bo Jarosz @Carleton.Ca**

### 2. Current position: Instructor.

**Research in physics of medical ultrasound:** Current interests incorporate laser generated ultrasound on solids, optical fibre sensor of ultrasonic fields, interaction of sonic waves with tissue, mode conversion in tissues, and methods of interstitial generation of local hyperthermia.

### 3. Member of MPORU.

### 4. Polish Ministry of Science Award for Individual Research.

Four Rector of Warsaw Technical University Awards for Research.

Four Rector of Warsaw Technical University Awards for Excellence in Teaching.

Carleton University Award for Professional Achievement.

### 5. Education: Ph.D. in Physics with Distinction, 1975, Warsaw Technical University, Poland.

M.Sc. in Physics, 1966, Warsaw University, Poland.

**Employment:** Sessional Lecturer/Research Associate; Instructor II, Carleton University, September '83 -

Assistant Professor, Port Harcourt University, Nigeria, March '77 - August '83.

Assistant Professor, Warsaw Technical University, December '74 - March '77.

Research and Teaching Associate, Warsaw Technical University, September '66 - December '74.

### 6. Professional Affiliations: Member of IEEE Engineering in Medicine and Biology Society, and of IEEE Ultrasonic, Ferroelectrics, and Frequency Control Society.

### 7. Recent Publications in Medical Physics:

*Ultrasonic Interstitial Heating in Phantoms, 11th International Conference of IEEE Engineering in Medicine and Biology Society, 1989.*

*Rate of Heating by Interstitial Ultrasonic Hyperthermia Applicator, 10th CCPM/DMBP Annual Symposium, 1989.*

*Ultrasonic Hyperthermia by Invasive Technique, 1987 CAP Congress (with R. L. Clarke).*

## Paul C. Johns

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Carleton University  
Ottawa, Ontario  
K1S 5B6

**Telephone:** 788-4317  
**FAX:** 788-4389  
**E-Mail:** JOHNS@NRCHEP.NRC.CA

**Current Position:** Assistant Professor, Department of Physics, Carleton University

**Research Interests:** The basic physics of medical x-ray imaging, specifically: artefacts in CT images due to scatter and x-ray energy spectrum effects, the production of monoenergetic x rays, and the extraction of diagnostic information from scattered radiation.

**Professional Activities & Appointments:** Lecturer, Department of Radiology, University of Ottawa  
Consulting Scientific Research Staff, Radiological Sciences, Civic Hospital  
Reviewer for the journal Medical Physics

**Previous Employment:** 1986-1988 Ontario Cancer Treatment & Research Foundation:  
Medical Physicist attached to Radiological Sciences,  
Ottawa Civic Hospital  
1977-1979 Atomic Energy of Canada Ltd., Mississauga, Ont.:  
Nuclear Generating Station Safety Analyst

**Education:** 1982-1986 PhD } Medical Biophysics, U of Toronto  
1979-1982 MSc } Supervisor: Dr. Martin J. Yaffe  
1973-1977 BAsC Engineering Science, U of Toronto  
Nuclear & Thermal Power Option

**Professional Affiliations:** AAPM American Association of Physicists in Medicine  
CAP Canadian Association of Physicists  
IRPS International Radiation Physics Society

**Professional Certifications:** MCCPM Member, Canadian College of Physicists in Medicine  
P.Eng. Professional Engineer

**Awards and Honours:** Charles E. Ives Engineering Award,  
for an outstanding paper published in the *J of Applied Photographic Engineering* in 1983 (with M.J. Yaffe).  
Sylvia Sorkin Greenfield Award, for best paper published in *Medical Physics* in 1983 (with M.J. Yaffe).  
2nd place in the Young Investigators' Symposium, AAPM Annual Meeting, Chicago, July 1984.

**Some Typical Publications:** P.C. Johns and M.J. Yaffe, "X-Ray Characterisation of Normal and Neoplastic Breast Tissues", *Physics in Medicine and Biology* **32**, 675-695 (1987).

P.C. Johns, D.J. Drost, M.J. Yaffe, and A. Fenster, "Dual-Energy Mammography: Initial Experimental Results", *Medical Physics* **12**, 297-304 (1985).

P.C. Johns and M.J. Yaffe, "Coherent Scatter in Diagnostic Radiology", *Medical Physics* **10**, 40-50 (1983).

10 Aug 1989

## Norman V. Klassen

**Address:** National Research Council of Canada  
Ionizing Radiation Standards, Bldg. M-35  
Ottawa, Ontario K1A 0R6 Canada

Telephone: 613-993-9352  
Fax: 613-954-7708  
BITNET: KLASSEN at NRCVM01

**Position and Research Interests:** Senior Research Officer

Member of the Ionizing Radiation Standards Section of the Basic Standards Laboratory working primarily on radiation chemistry problems.

Pulse radiolysis of aqueous liquids, glasses and crystals from 2K to room temperature, with a special interest in  $e_{tr}^-$ , a type of trapped electron discovered by this group.

Pulse radiolysis of liquid and glassy hydrocarbons with a special interest in the decay kinetics of the trapped electron and the initial positive ion.

Currently involved in a comparison of final products in alkanes irradiated at low and high dose rates with a view to quantifying certain free radical processes.

Currently involved in a comparison of mammalian cell survival following irradiation at low and high dose rates, aerated and hypoxic.

Currently involved in the development of water calorimetry as a standard for absorbed dose to water, with a special interest in the radiation chemistry of dilute aqueous solutions.

**Committees:**

Advisory Board of the Radiation Chemistry Data Center, University of Notre Dame

**Education:**

Ph.D. - McGill University, Montreal (1957) Physical Chemistry

Ph.D. - University of London, London U.K. (1961) Physical Organic Chemistry

**Honours:**

Fellow of the Chemical Institute of Canada

**Representative Publications:**

1. "A study of trapped electrons in  $LiCl/D_2O$  and other aqueous glasses at temperatures down to 2K by radiolysis, pulse radiolysis, photolysis and stimulated luminescence", *J. Phys. Chem.* 57 1488-1499 (1979).
2. "Cations and electrons in hydrocarbon glasses and liquids studied by pulse radiolysis", *J. Phys. Chem.* 89, 2048-2053 (1985).
3. "Increased sensitivity of mammalian cells irradiated at high dose rates under oxic conditions", *Int. J. Radiat. Biol.* 37 331-335 (1980).
4. "A Direct Comparison of Water Calorimetry and Fricke Dosimetry", *Phys. Med. Biol.* 34, 23-42 (1989).

## Gary H. Kramer

Bureau of Radiation and Medical Devices  
775 Brookfield Road  
Ottawa, Ontario  
K1A 1C1  
613 954 668

### PROFESSIONAL EXPERIENCE:

Currently Gary Kramer is head of Human Monitoring Laboratory (HML), Environmental Radiation Hazards Division, BRMD where he has worked since 1987. The HML is Canada's National Calibration Reference Centre. Duties include: Intercomparison Services for Canadian In-Vivo facilities (whole body, lung and thyroid). In-Vivo monitoring of possibly internally contaminated individuals, internal dosimetric calculations, design and fabrication of phantoms for calibration of Canadian facilities, systems manager for divisional mini-computer, and developing National Criteria for Bioassay and In-Vivo Monitoring.

Previously, Gary Kramer was employed by Atomic Energy of Canada Limited where he was head of Bioassay Laboratory and In-Vivo Monitoring Facility, Dosimetric Research Branch, Chalk River Nuclear Laboratories (CRNL). Duties included: Development of new bioassay (In-Vitro and In-Vivo) methods and testing, improving and documenting existing methods, implementing an in-house quality assurance program, developing improved monitoring methods, internal dosimetry, evaluation of internal contamination incidents and database administration. Research was aimed at understanding more fully the biological transport mechanisms of uranium in the human body by studying the metal ion chemistry under physiological conditions. At CRNL he was also a member of Unit 2000, a multi-disciplinary group created to pioneer work in hyperthermia, intelligent sensing and stable isotope production.

To date, he has published 22 papers and 55 reports in various areas of radiation protection (dosimetry, radiochemical procedures, in-vivo procedures, QA documentation).

### PROFESSIONAL AFFILIATION AND COMMITTEE MEMBERSHIPS

Member since 1979, Canadian Radiation Protection Association, Chairman of Membership Committee (1984-1986), Director (1986-1988), Scholarship Fund Committee (1988-present), Nominating Committee (1989-present)

Member since 1980, Health Physics Society

Member, Canadian Federal/Provincial Working Group on In-Vivo and Bioassay Monitoring Criteria, Chairman (1987-present)

Member, IAEA Technical Committee Meeting on Rapid Monitoring of Large Groups of Internally Contaminated People (TC-685), 1989



## Deirdre A. Morison

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ADDRESS: Department of National Health and Welfare  
Room 66, Health Protection Building  
Tunney's Pasture, Ottawa, Ontario, K1A 0L2

CURRENT POSITION: Head, Non-Ionizing Radiation Section  
Bureau of Radiation and Medical Devices

The function of this position is to lead a group of scientists and technical inspectors specializing in the protection of Canadians from the harmful effects of non-ionizing radiations. The group is formed into 3 units: (i) Electromagnetics (powerline frequencies, radio transmissions, VDT's, microwaves, radar, etc.); (ii) Electro-optics (ultraviolet, infrared and visible radiation, lasers); and (iii) Acoustics (ultrasound, infrasound and noise).

The present research interests of the group include: ultrasound dosimetry, investigation of the specific absorption rate (SAR) in humans for a range of frequencies, the effects of 60 Hz power line frequencies on cancer promotion and carcinogenesis, the biological effects of electro-optics, electro-optics measurements.

### CURRENT PROFESSIONAL APPOINTMENTS:

- Chairman of Canadian Advisory Committee (CAC) to International Standards Organization (ISO) Technical Committee on Acoustics (CAC/ISO/TC43).
- Member of American Conference of Government Industrial Hygienists (ACGIH) Physical Agent Threshold Limit Value (TLV) Committee.
- Member of Canadian Radiation Protection Association, Acoustical Society of America, Canadian Acoustical Association, Canadian Advisory Committee to IEC/TC87-Ultrasonics.

### PAST JOBS, EDUCATION, PROFESSIONAL AFFILIATION

- B.Sc. Physics, Nottingham University, 1967
- Association of Professional Engineers of Ontario - member since 1980.
- Physicist, Acoustics Radiation Unit, Dept. of National Health & Welfare, 1975-1984.
- Acoustics Regional Field Manager, Ontario Ministry of the Environment, 1973-1975.
- Noise Consultant, Ontario MOE and Independent, 1971-1973.
- Acoustics Test Engineer, Vibro-Acoustics and Vibron, 1970-1971.
- Noise Engineer, Rolls-Royce Aero-Engine Division (U.K.), 1967-1969.
- Editor, Canadian Acoustics, Quarterly publication of Canadian Acoustical Association, 1980-83.

### SAMPLE PUBLICATIONS

D.A. Morison (1989), "1988 Update on regulating occupational exposure to noise", Canadian Acoustics, 17(1), January, pp.3-31.

D.A. Morison (1989), "Canadian National Guidelines for Environmental Noise Control - Procedures and Concepts for the Drafting of Environmental Noise Regulations/By-laws in Canada", J. Acoust. Soc. Amer., Supplement 1, Vol.85, Spring, p.S45.

D.A. Berwell (1985), "Protective Measures for Ultrasound Exposure", Ultrasound in Medical Applications, Biological Effects and Hazard Potential, Editors M.H. Repacholi, M. Grandolf and A. Rindi, Plenum Pub. Corp., New York, 1987, pp.247-253.



## Alan Mortimer

Business      Senior Research Officer      Tel. 613-993-1609  
 Address:      NRC / Division of Electrical Engineering      Fax. 613-952-7988  
                  Ottawa, Ontario K1A 0R6

Education:      Carleton University      Physics 1972  
 B.Sc.           Ottawa, Canada

M. Sc.          Carleton University      Medical Physics 1974

Ph.D.          Guy's Hospital Medical      Medicine 1989  
                  School, Univ. of London      (non-clinical)

### Professional Qualifications and Affiliations:

- 1978          Membership Committee Canadian Medical and Biological Eng. Society
- 1979          Member - Bioeffects Committee of American Institute of Ultrasound in  
                  Medicine
- 1983          Chairman - Canadian National Committee of International Electrotechnical  
                  Commission 29D Electroacoustics
- 1984          Secretary - Life Sciences Subcommittee of Interdepartmental Committee on  
                  Space
- 1984          Vice-Chairman AIUM Bioeffects Committee
- 1985          Chief Mission Scientist Canadian Life Sciences Space Flight
- 1986 - 88      Chairman AIUM Bioeffects Committee

### Research Interests

Biological Effects of Ultrasound  
 Acoustic Cavitation  
 Tissue Characterization  
 Ultrasound Diagnostic Instrumentation

### Graduate Topics

Methods for detecting coronary plaque in vessels for use in laser surgery  
 (numerical techniques)  
 Prediction of safe levels from ultrasound cavitation in vivo

## G. Peter Raaphorst

- Address:** Ottawa Regional Cancer Centre, 190 Melrose Avenue, Ottawa, Ontario, K1Y 4K7
- Positions:** Head of Medical Physics, Ottawa Regional Cancer Centre, Civic and General Hospitals; Adjunct Professor of Physics, Carleton University; Assistant Professor Department of Radiology, University of Ottawa; Adjunct Professor Department of Biology University of Ottawa; Allied Scientific Staff, Department of Radiology, Civic Hospital.
- Education:** B.Sc., M.Sc. and Ph.D. degree from the Department of Physics University of Waterloo; Post-doctoral training, Department of Radiology and Radiobiology in Colorado State University, Colorado, U.S.A.
- Awards:** 1) Ontario Scholarship; 2) Lester B. Pearson, Prime Minister's Award for excellence; 3) Isaac Newton Award for excellence in physics, University of Waterloo; 4) National Research Council of Canada, Pre-doctoral scholarship; 5) Medical Research Council of Canada Post-doctoral scholarship; 6) New Ideas and Innovations Award, Atomic Energy of Canada.
- Grants:** 1) Peer Review Funding from NCIC and NSERC.
- Professional Experience:** 1976-1978 Department of Radiology and Radiobiology, Colorado State University; 1978-1985 Research Scientist in Medical Biophysics, Atomic Energy of Canada; 1985 Head of Radiobiology Section of Medical Biophysics Branch, Atomic Energy of Canada; 1985 - Present Head of Medical Physics, Ottawa Regional Cancer Centre.
- Memberships:** 1) Radiation Research Society; 2) North America Hyperthermia Group; 3) Canadian Association for Radiation Oncology; 4) Federation of Biological Sciences
- Publications:** Over 100 publications. Some examples:
1. G.P. Raaphorst, J. Kruuv and M.M. Pintar. Nuclear magnetic resonance study of mammalian cell water. *Biophysical Journal* 15, 391-402, 1975.
  2. G.P. Raaphorst, J.A. Vadez et al. Comparison of heat and/or radiation sensitivity and membrane composition of 7 x-ray transformed malignant cell lines and normal cells. *Cancer Research*. 46, 14-19, 1986.
  3. G.P. Raaphorst et al. A study of heat and radiation response of malignant melanoma cell line developed in culture by radiation induced transformation. *Int. J. Rad. Onc.* 12, 2151-2155, 1986.
  4. G.P. Raaphorst et al. A comparison of heat and radiation sensitivity of three human glioma cell line. *Int. J. Rad. Onc.* In press, 1989.
- Research Interests:**
1. A study of mammalian cells and their responses to new therapeutic strategies used in the clinic, such as different combinations of radiation, hyperthermia and drugs
  2. A study of development of hyperthermia techniques and technology to administer clinical hyperthermia for the purpose of cancer treatment.
  3. Magnetic resonance imaging and spectroscopy as applied to the evaluation of therapeutic responsiveness of human and animal tumor systems.

## David W.O. Rogers

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Mail: Laboratory for Basic Standards, Physics Division, NRC, Ottawa K1A 0R6

### Current Position

I have worked since 1973 as a research officer in the Physics Division of the National Research Council of Canada (NRCC). Since 1984 I have been the head of the 14 person Ionizing Radiation Standards Section which has responsibility for Canada's primary measurement standards for ionizing radiation. My research involves radiation dosimetry and the development of Monte Carlo techniques for simulating the transport of electrons and photons in materials and the application of these and other techniques to problems in medical physics and radiation dosimetry.

As an adjunct Professor at Carleton, I hold an NSERC grant to support graduate students working in the NRC lab.

### Related Professional Activities

1988 on: Member of the American Association of Physicists in Medicine's (AAPM) Radiation Therapy Committee which commissions and approves all AAPM therapy-related protocols and oversees the work of the Radiation Physics Center in Houston.

1987 on: Member of the ICRU (International Commission on Radiation Units and Measurements) report committee on "Absorbed Dose Standards for Photon Irradiation and Their Dissemination".

1987 on: Canadian representative on the Comité Consultatif pour les Étalons de Mesure des Rayonnements Ionisants, the committee of the Bureau International des Poids et Mesures which is responsible for maintaining the world's primary standards for exposure and absorbed dose.

1987 on: Associate Editor and member of ad hoc executive committee of Medical Physics, the official journal of the AAPM.

1987: Co-director of the International School on "Monte Carlo Transport of Electrons and Photons Below 50 MeV" held at the Ettore Majorana Centre for Scientific Culture in Erice, Italy.

1984-1986: Member of Task Group 21 of the AAPM's Radiation Therapy Committee which updated the AAPM's protocol for dosimetry in radiotherapy beams.

1981 to 1985: On executive of Division of Medical Physics of the Canadian Association of Physicists, including Chairperson, 1983/84.

I have given 15 invited talks at national and international conferences and 36 invited external seminars.

### Awards

CAP's Sylvia Fedoruk Prize in Medical Physics, awarded for co-authoring the "best" Canadian paper in the field of medical physics in 1988.

**Education:** B.Sc(1968), MSc(1969) and PhD(1971), all U of Toronto.

### Publications

45 refereed papers, 10 papers in proceedings, 7 review chapters and 29 internal reports.

Differences in Electron Depth Dose Curves Calculated with EGS and ETRAN and Improved Energy Range Relationships. *Medical Physics* 13 (1986) 687-694; D.W.O. Rogers and A.F. Bielajew.

Generation of photon energy deposition kernels using the EGS Monte Carlo code. *Phys. in Medicine & Biol.* 33 (1988)1-20.; T. R. Mackie, A.F. Bielajew, D.W.O. Rogers and J.J. Battista.

The Role of Humidity and Other Correction Factors in the AAPM TG-21 Dosimetry Protocol. *Medical Physics* 15 (1988) 40-48; D.W.O. Rogers and C.K. Ross.

Monte Carlo techniques of electron and photon transport for radiation dosimetry, in "The Dosimetry of Ionizing Radiation", Vol III, eds. K.R. Kase, B.E. Bjarngard, and F.H. Attix, published by Academic Press, 1990 D.W.O. Rogers and A.F. Bielajew.

The EGS4 Code System. Stanford Linear Accelerator Center Report SLAC-265 (Stanford Calif, Dec 1985)(400 pages) W.R. Nelson, H. Hirayama and D.W.O. Rogers.

## Carl K. Ross

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Ionizing Radiation Standards, Bldg. M-35  
Ottawa, Ontario K1A 0R6 Canada

**Telephone:** 613-993-9352  
**Fax:** 613-954-7708

### **Position:**

Member of the scientific staff (seven scientists, five technicians) of the NRC section responsible for ionizing radiation standards.

Responsible for the day-to-day operation of the NRC linear accelerator.

### **Research Interests:**

- development of high energy photon and electron absorbed dose standards;
- measurement of bremsstrahlung spectra;
- water calorimetry as an absorbed dose standard;
- dose rate effects in radiation biology.

### **Education:**

B.Sc. - Mount Allison, Sackville, N.B.

M.Sc. - McMaster University, Hamilton

Ph.D. - McMaster University, Hamilton

### **Membership:**

CAP, DMBP.

### **Recent Publications:**

C.K. Ross, N.V. Klassen, K.R. Shortt and G.D. Smith, *A Direct Comparison of Water Calorimetry and Fricke Dosimetry*, Phys. Med. Biol. 34, 23-42 (1989).

C.K. Ross, N.V. Klassen, editors, NRC Workshop on Water Calorimetry, NRC-29637.

D.W.O. Rogers and C.K. Ross, *The Role of Humidity and other Correction Factors in the AAPM TG-21 Dosimetry Protocol*, Med. Phys. 15, 40-48 (1988).

## Ken. R. Shortt

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### Position:

Associate Research Officer involved in ionizing radiation dosimetry for cancer therapy beams (electrons and photons of  $^{60}\text{Co}$  and high energy) using ionization chambers, chemical dosimeters, calorimeters, solid state detectors (diodes), ... .

### Committees:

AECB sponsored working group on external dosimetry (personal radiation monitoring).  
IEC Technical Committee 62 on radiation equipment and dosimeters.

### Education:

B.Sc. - McMaster University, Hamilton  
M.Sc. - University of Western Ontario, London  
Ph.D. - University of British Columbia, Vancouver

### Previous Employment:

British Columbia Cancer Institute (Medical physicist - 3 years)  
Swiss Institute for Nuclear Research (pion Dosimetry - 1 year)

### Typical Publications:

K.R. Shortt and R.M. Henkelman, "Ionization Chamber Measurements of a Pion Beam", Rad. Res. 85, 419-431 (1981).  
K.R. Shortt, C.K. Ross, A.F. Bielajew and D.W.O. Rogers, "Electron Beam Dose Distributions Near Standard Inhomogeneities", Phys. Med. Biol. 31, 235-249 (1986).  
C.K. Ross, N.V. Klassen, K.R. Shortt and G.D. Smith, "A Direct Comparison of Water Calorimetry and Fricke Dosimetry", Phys. Med. Biol. 34, 23-42 (1989).

### Possible Thesis Topics:

ion chamber wall materials  
recombination in electronegative gases  
interface dosimetry  
high total doses using e.g. alanine esr  
alternative methods for water calorimetry



