IOP | Institute of Physics
Medical Physics Group

NEWSLETTER
Issue No 3
December 2010

A Word from the MPG Chair

Welcome to the latest Medical Physics Group Newsletter! In this edition we follow up on ongoing issues relevant to clinical, industrial and academic physicists; firstly the department of health's *Modernising Scientific Careers* (MSC) programme is set to be implemented (see Modernising Scientific Careers, the UK Way Forward: (www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/@ps/documents/digitalasset/dh_113990.pdf), having a significant impact on the training for healthcare scientists. *Peter Sharp* gives us an update on progress and the next steps.

Secondly, in light of the recommendations of the 2008 Wakeham review of academic physics departments (www.rcuk.ac.uk/review/physics), we have the first of a number of articles spot-lighting on successful collaborations between clinical and academic departments by *Nick Stone* and *Dareyoush Rassi.* We would welcome similar contributions from any MPG members who have successfully bridged the gap between clinical or industrial applications and academic physics departments.

The Group's now traditional one day meeting and AGM, held during *IPEM's Medical Physics and Engineering Conference* (Nottingham 14th–16th September), was this time organised jointly with the *Biological Physics Group on Mathematical and Computational Modelling in Medicine and Biology*. The meeting was well attended and covered modelling on scales from the atomic to the whole body. *Martin Robinson* and *Sarah Harris* report on the invited and proffered talks.

We have several reports on scientific meetings attended by research students receiving IOP travel bursaries. Applications are welcome centrally for PhD students (www.iop.org/about/grants/research_student/page_38808.html) or alternatively via the MPG committee directly for anyone early in their career who is not studying for a PhD but is presenting scientific work at an international conference.

Additional group activities include working with related IOP groups to update and develop medical physics teaching materials for schools and responding to national consultations on issues relevant to the group where appropriate.

As always the MPG committee would welcome input from its members, currently standing at just under 800 in total, such as newsletter contributions and suggestions for scientific, outreach and educational activities.

Colin Baker
MPG Chair

48th meeting of the Particle Therapy Co-Operative Group (PTCOG), 28th Sept – 3rd Oct 2009, Heidelberg, Germany

The PTCOG meetings are becoming ever more popular year-on-year, following the expanding uptake of radiotherapy with protons and ions at an almost exponential rate. The meeting is aimed at mainly medical physicists and oncology physicians in the field of particle therapy, in order to share information between particle therapy centres and research institutes on the latest technological and clinical progress that has been made.

This year's meeting was a great success, and attracted several hundred delegates over the 6 day meeting. It was hosted in the picturesque town of Heidelberg in Germany, and organised by the members of the *Heidelberg Ion Therapy* (HIT) centre where an impressive *multiple-ion therapy facility* has been built and is soon to come online for treatment. Many luminary figures in the field attended, and this provided an excellent opportunity for discussion and networking outside of the talks. The first 3 days comprised an *educational session,* where the highlights included a talk on new ion accelerator concepts by *Dr. Markus Roth,* covering the dielectric wall (DWA) and fixed-field alternating gradient (FFAG) accelerators as well as the burgeoning field of laser-plasma acceleration. Also of significant interest was the presentation given by *Dr. Christoph Bert* on the interplay effects of target motion when using a raster-scanned particle beam, which set the scene for several talks later in the week on different ways of dealing with tumour motion during irradiation.

For the *scientific session,* aside from a lot of clinical data on local control and 3- and 5-year survival rates for a wide range of tumour types, the main physical issues which were presented were ways of coping with *uncertainties of particle range in real patients,* the latest *radiobiological models for determining the biological dose to patients, and how to make treatment plans more robust to intra- and inter-fractional motion.*

There were two opportunities during the week for delegates to tour the new HIT facility, and this was a notable highlight. The sheer scale of the 600 ton ion isocentric gantry, rotatable with millimetre accuracy (the mechanical extent of which is hidden from patient view) was awesome. This technology means that a patient lying on a couch can be treated with a *beam of protons or carbon ions* (and in the future *helium-3* and *oxygen ions*) from any angle, maximising treatment capabilities. It is the first *raster scanning ion-beam radiotherapy gantry* in the world.

By attending this meeting, I have learnt greatly from the wealth of information presented and also the opportunity to make new contacts and discuss research with other people in the field of particle therapy. It also gave me the opportunity to present my work in the *dosimetry of a laser-proton source* in the form of a poster, and to also see the research being done by other students in the field.

Daniel Kirby
The University of Birmingham

Biophotonics Research Unit, Gloucestershire Royal Hospital and Cranfield University

Biophotonics – 'the use of light to measure biological changes that relate to disease'

In 1995 a collaboration was established between *Cranfield University and Gloucestershire Royal Hospital.* This combined academic research with surgical expertise *(Prof Hugh Barr)* and Medical Physics *(Prof Angela Newing).* The entity was established as the *Cranfield Postgraduate Medical School.* This developed over the years to include other district general hospitals Bedford and Northampton.

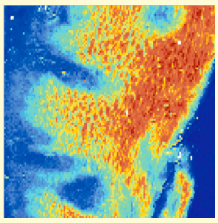
The *Biophotonics Research Unit* in Gloucestershire was formed from a shared vision for cutting edge healthcare innovation. *Prof Nick Stone* (a NIHR Senior Research Fellow) leads the Biophotonics Research Unit based at Gloucester. The Unit's goals are to pioneer the field of novel optical diagnostics within the clinical environment. This involves numerous local, national and international collaborations with clinical, academic and commercial partners. A strong, internationally recognised, multidisciplinary group has been established made up of scientists (physicists, chemists and biologists) and clinicians (surgeons mainly). The group is leading research into *Raman spectroscopic diagnostics* for in vivo and in vitro discrimination of early cancers. Other work by the group includes *mid-IR hyperspectral imaging* of tissues for pathological diagnostics; *optical coherence tomography* for real-time surgical targeting of disease and biopsy selection; *photodynamic therapy* for early cancers and dysplasias; *"sniffing" disease with electronic noses* (volatile analysis techniques) for the detection of infections.

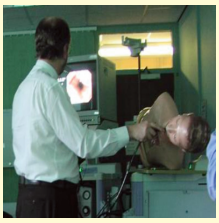
The Unit functions as an academic unit within the hospital and is fully funded by research grants. Staff are employed by the Trust and given honorary appointments at the university to enable them to undertake their academic roles with the same status as the salaried staff (but without the salary!). The Unit currently has a senior lecturer and three other postdoctoral staff – *Dr Catherine Kendall* (S Lec), Dorothy Hodgkin Research Fellow, Royal Society; *Dr Joanne Hutchings,* NIHR Postdoctoral Research Fellow; *Dr Gavin Rhys Lloyd,* postdoctoral research fellow and *Dr Gavin Erry* who is a senior scientist at the National Physical Laboratory. The team support and lead the research of the unit in conjunction with *Prof Hugh Barr* (Consultant Surgeon) and *Prof Neil Shepherd* (Consultant Histopathologist). Doctoral research students are multidisciplinary from physicists and chemists to biologists and surgeons. Jointly supervised research studentships (based in Gloucester and registered at Cranfield) include 7 PhDs, 4 DMs and 1 MSc by research (registered at Bristol).

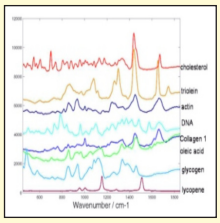
The unit's work includes exploring basic science coupled to numerous collaborative translational research studies leading to publication of over 100 peer reviewed papers, book chapter, international proceedings and patents; leading three national clinical trials (within the Cancer Research Network Portfolio); collaboration with at least 20 senior clinical staff and their teams within the Trust; collaboration with numerous commercial, academic and NHS institutions within the UK and internationally; numerous prizes for excellence; raising grant funding of around £5.5 million.

Nick Stone
Biophotonics Research Unit
Gloucestershire Hospitals NHS Foundation Trust

A team from the Unit won Best Medical Technology in the Biotechnology YES competition in 2009







International Nuclear Conference 2009 & Exhibition (INC'09), 29th June – 1st July 2009, Putra World Trade Centre (PWTC), Kuala Lumpur, Malaysia

The *International Nuclear Conference,* held in Kuala Lumpur, Malaysia on 29th June to 1st July 2009 had attracted 200 delegates across the globe and assembled the decision makers, power generation institutions, financial institutions, researchers, academics, private entities, vendors, utility operators, legal practitioners, regulators, engineers, equipment manufacturers, environmentalists and students. The conference focused on the *future of a nuclear power program* in Malaysia as well as the *non power application of nuclear technology* including application in medicine and healthcare. Such non-power application has been the main focus of nuclear technology development in Malaysia until now, and this conference was an initiative to expand this and provided a forum to discuss the issues and problems regarding the growth of a nuclear power program.

Experience shared by nuclear power plant experts from countries such as China, Finland, German, Japan and South Korea as well as regulation bodies such as *IAEA,* which plays an important part in influencing discussions on Malaysia's nuclear power program. *Malaysia's* nuclear power programme can start with a small nuclear power plant as a power demonstrator reactor before larger and more cost-competitive plants are built. This is similar to approach taken by *Japan,* which started with a power demonstration reactor generating only 13 megawatts of electricity from 1963 to 1982 before building 53 larger plants with capacities of between 340 and 1,300 megawatts that supplied almost 30 percent of Japan's total electricity requirements. *South Korea* also had shown that various types of small-scale nuclear reactors are capable of providing 40 percent of the country's power needs.

In order to support nuclear technology applications, development of the relevant legal framework and regulatory provisions by various regulatory agencies in Malaysia is required. Experts are also very much needed for the development and the maintenance of this technology and this can be achieved through the establishment of appropriate academic and training programmers with support from international cooperation.

The non power application of nuclear technology was also discussed during the seminar. It is a more established field of nuclear science in Malaysia and this is seen as an entry point to a nuclear power program. Few participants presented their research in *medical applications of nuclear technology* on the second day of the seminar. This included the *application of radioisotopes in nuclear imaging and dosimetry techniques.* In this conference, myself had presented part of my PhD work on *a novel dosimetry of optical fibre for radiotherapy application,* this study was done by the dosimetry group in Department of Physics, University of Surrey, lead by *Dr David A Bradley.*

This conference had become a successful platform to share knowledge and experiences among the participants, as well as to discuss all the aspects of nuclear power and non power application. Hopefully, the initiative on developing a nuclear power program in Malaysia had to grasp loads of input from this conference and will become a reality.

AT Abdul Rahman
University of Surrey

CARS 2010, 23rd–26th June, Geneva, Switzerland

The *24th Computer Assisted Radiology and Surgery Conference* (CARS) was held in Geneva on 23-26 June 2010. CARS focuses on *research and development for computer assisted systems and their applications in radiology and surgery.* It hosts satellite conferences and meetings on *Computer Aided Surgery, Picture Archiving and Communication Systems, Computer Aided Diagnosis and Maxillofacial Imaging.*

This year more than 900 people participated in CARS with the audience being a mixture of physicists and engineers from academia and industry, as well as, clinical experts mostly radiologists and surgeons. The organisers put together a well structured scientific program comprising oral presentations, posters and tutorials, with up to four key research areas running in parallel sessions. Sessions started with invited lectures introducing state of the art research in each field, followed by oral talks presenting the latest research. Sessions were lively, with multiple questions following each presentation and strong participation in panel discussions. The poster session comprised more than 150 posters grouped according to subject, and was open throughout the conference. In addition to the talks and posters, an industrial fair complemented the conference presenting the latest medical technological developments in medical image processing and computer assisted surgery.

I represented UCL with an oral talk on *computer aided diagnosis of intervertebral disc herniation from magnetic resonance images of the lumbar spine.*

My personal highlights of the conference include the invited lecture by *Professor Bram van Ginneken* on computer aided diagnosis of lung cancer from CT images, and the workshop on computer aided diagnosis systems with live demonstrations of research prototypes.

All conference papers have been published in the *International Journal of Computer Assisted Radiology and Surgery* (Vol. 5, Supl. 1, 2010) and can be found online at www.springerlink.com.

Concluding, this conference not only presented the latest research in computer assisted radiology and surgery, but also offered an insight on the application of research results in clinical practice. CARS promotes the exchange of ideas between clinical experts, engineers and physicists, and is a good place for meeting leading scientists in the field of medical imaging and starting new collaborations.

CARS 2011 will be held in Berlin, next June.
I would like to thank the *Institute of Physics* for sponsoring my participation in this outstanding event.

Sofia Michopoulou
University College London

Computational Biomedical Physics Meeting, Nottingham, 2010

This was a new one day meeting organised jointly between the *Medical Physics Group* and the *Biological Physics Group* of the IOP on 14th September 2010. It was an extension to the *Institute of Physics and Engineering in Medicine* (IPEM) annual *Medical Physics and Engineering Conference* (MPEC) which was held in Nottingham this year.

The aim of this computational section of the conference was to bring together researchers in Biological Physics and Medical Physics modelling to inspire new collaborations between the two fields. The meeting covered time and length scales from atomistic simulation to models of the whole body. There were between 30 and 40 attendees present at the meeting.

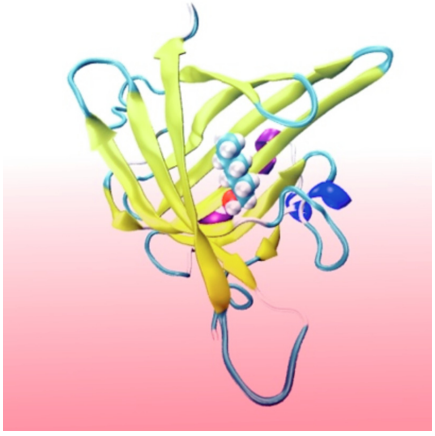
They enjoyed talks by five invited speakers, who covered topics as diverse as simulations of individual biomolecules (*Charlie Laughton,* Nottingham), mesoscopic models of DNA and lipids for drug delivery (*Syma Khalid,* Southampton), heart modelling (*Richard Clayton,* Sheffield), modelling of solid cancerous tumours (*Helen Byrne,* Nottingham) and models of the activity of the brain (*David Halliday,* York). Contributed talks also covered a wide range of computational research projects, including modulating protein/protein interactions with drugs (*Jon Fuller*, Leeds), systems biology of cell death (*Tongli Zhang,* Oxford), fractal dimensions of cell growth (*Jon Blackledge,* Dublin), the dielectric response of tissues (*Janet Clegg,* York) and polarisation enhanced X-ray imaging (*Zdenka Kuncic,* Syndney). The poster presentations were similarly diverse.

An atomistic model of the protein MUP, showing a bound ligand. Thank you to Steve Homans for providing the simulation data and Kate Howarth for making the picture.

The meeting also featured a questionnaire where delegates were asked for their opinions about the barriers to collaboration between "academic" and "clinical" modellers, their ideas as to how these might be overcome, and the potential scientific benefits to the two disciplines. This generated a lively debate, and many interesting ideas.

The barriers to communication that were identified were the *different languages and priorities of the two communities.* Suggestions for overcoming these were future meetings involving the two communities, the standardisation of computer codes and computational methodologies, PhD studentships jointly supervised between the two disciplines, developing simple language for communication, and most importantly taking the time to effectively communicate with colleagues from the opposite discipline.

The potential scientific benefits that were identified, however, indicated that this increased effort could be well worth the investment. Firstly, such collaboration would prevent one or the other discipline "reinventing the wheel". It would also provide modellers with access to clinical data to validate their models. A common theme was achieving overlap between the various time and length scales (molecular, cellular networks, tissue modelling) that are vital to both Biological and Biomedical Physics. Clearly, this is an area in which further communication and collaboration should be strongly encouraged.



An atomistic model of the protein MUP, showing a bound ligand. Thank you to Steve Homans for providing the simulation data and Kate Howarth for making the picture.

Sarah Harris
University of Leeds

Martin Robinson
University of York

International Symposium on Standards, Applications and Quality Assurance in Medical Dosimetry, IAEA, Vienna, Austria

In early November, I attended the *International Symposium on Standards, Applications and Quality Assurance in Medical Radiation Dosimetry* (IDOS) at the *International Atomic Energy Authority* (IAEA), Vienna. I presented a poster on *'simulated clinical effect of in-vivo diode perturbation in megavoltage photon beam radiotherapy'* which was research work undertaken during my Part 1 radiotherapy training at Oxford Radcliffe Hospitals NHS Trust.

The conference was opened by presentations from the IAEA, Bureau International des Poids et Mesures, and International Commission on Radiation Unites and Measurements. The IAEA launched their new portal http://humanhealth.iaea.org which is worth visiting as it contains a wealth of e-learning material. The IAEA also announced that they would be publishing, in January 2012, handbooks for Nuclear Medicine and Diagnostic Radiology to complement their existing handbook on Radiotherapy.

The slides of almost all the presentations given at IDOS are available at http://nucleus.iaea.org/HHW/MedicalPhysics/IDOS/IDOS_web.pdf. Each morning courses were run at 8 am, prior to the conference starting, which were very well attended (especially considering the time!). These were on *Formalism for Internal Dosimetry in Nuclear Medicine, Clinical Dosimetry* in Paediatric Imaging, and Beyond TG-43 to Improve Brachytherapy Dosimetry. Again, the slides from these are available at: http://nucleus.iaea.org/HHW/MedicalPhysics/IDOS/IDOS_courses.pdf. In addition to plenary sessions and courses there were also round table discussions. These consisted of a group of experts each making initial points followed by discussion with the delegates. Topics discussed included: *When Dosimetry Goes Wrong in Therapy and Imaging, Dosimetry Challenges Associated with New Technology, Education and Training for Radiation Dosimetry, and What Does Calibration Traceability Mean to You. As delegates from 72 countries were attending it was fascinating to hear their comments on these issues.*

I was particularly interested in the talks given on nuclear medicine dosimetry. A result, discussed at the symposium, which I found most surprising, was the high failure rate of radiotherapy beams from an audit in the USA. The audit defined a fail as one where a beam at a site had an output outside a 5% tolerance. They found that 15% of centres had a fail. They also examined changes in compliance and found it was improving over time but that each time a new methodology for calibration was published the compliance dropped (far less surprising!).

I would like to express my thanks to the *IOP Medical Physics Group* for their financial support which enabled me to present my work at this symposium.

Daniel McGowan
Oxford Cancer Centre
Oxford Radcliffe Hospitals Trust

International Thermal Spray Conference (ITSC) 2009, 4–7 May 2009, Las Vegas, Nevada, USA

The *International Thermal Spray Conference* (ITSC) is a well established conference which has been running for a number of years by ASM international. As well as the more general and traditional symposiums run at the conference, there were also a number of Special Symposia including one focused on Biomedical Applications.

The *Special Biomedical Symposium* was the symposium in which the two talks I gave were presented. I attended all of these symposia as well as some more general sessions. Given the breadth of applications to thermal spray technology there were a lot of attendees whose work focuses on very different applications from mine, such as thermal barrier coatings. The symposia were staggered so only a few overlapped with each other which enabled one to attend all the talks in your area of specific interest, alongside some in other fields as well. There were consequently some attendees of the biomedical symposium with a large amount of experience in coating technologies, but who less familiar with the biomedical genre, but could still give some useful input into discussions within the symposium.

The symposium was focused on developments concerning the use of thermal spray and related surface engineering technologies to produce coatings and surface conditions designed for biomedical applications. These included *conventional thermal spraying of hydroxy-apatite for the promotion of osteo-integration of prostheses,* but will also encompassed various novel developments related to the control of cell-surface interactions, cell adhesion mechanisms, cell proliferation etc. Issues relating to the tailoring of surfaces including *biochemical compatibility, the scale and morphology of surface roughness and surface-connected porosity, coating adhesion, tribological properties* etc were also discussed.

Both talks I gave *("Strength of the Interface between Cells and Titanium Oxide-Based Coatings, measured using an Ultracentrifuge"* and *"In Vitro Human Osteoblast Responses to Titanium Oxide-Based Surfaces with Varying Topology and Composition")* were well attended. The presentations went smoothly and seemed to be positively received, with multiple questions asked afterwards. Questions predominantly focused on the biological techniques used, with which many attendees were less familiar, due to the conference attracting predominantly physical scientists.

Similar themes arose in multiple presentations throughout the day, such as the importance of which phase of titania (rutile or anatase) is present in coatings which are formed and how this can affect how cells sense a surface, and there was a lively exchange of ideas between many of us present and ideas have been sparked of further work I could carry out. The conference was very successful in getting to know others working in a similar field due to the lively debates which occurred after talks throughout the symposium.

It was reassuring to discover that the challenges we have identified working in this field and the questions we have and are trying to understand are the same that others working in this area have identified. Discussing these questions with each other was very helpful. I now have a number of people in labs across the world whom I can email to bounce ideas of which is likely to prove very useful in the future.

Helen Griffiths

Modernising Scientific Careers

As mentioned in a previous Newsletter, the way in which physicists are trained to work as Medical Physicists in the NHS is currently under review. A consultation on the proposed system, known as *Modernising Scientific Careers* (MSC), was carried out in early 2009. The outcome of that exercise, *"Modernising Scientific Careers: The UK Way Forward",* was issued in February 2010. Not surprising, despite there being many concerns expressed about the process, this document differed very little from the original proposal.

The situation now appears to be that the first people to be trained according to MSC will be recruited in early 2011, for a start in September 2011. Part of MSC is a *part time MSc in Healthcare Science* (Medical Physics). The IPEM hosted two meetings earlier in the year when members of the MSC team met with the providers of current MSc programmes in Medical Physics. This was the first time that providers had seen a version of the curriculum and learning outcomes and it was clear that there were significant differences between what it required and what was currently being delivered. In general there was concern that it reduced the academic content significantly, both by introducing more generic skills into the syllabus at the expenses of physics, and in requiring more specialisation in a particular branch of medical physics. In the past many of the generic, professional skills, were provided outside the MSc course, and the specialisation raises concerns that this will produce a physicist who is less qualified to deal with changes as their career progresses.

It would appear that the intention is to concentrate training in a small number of centres although the tender for those centres has yet to be issued. What will happen to the other MSc courses is obviously unknown at present.

The main concern of the *IOP Medical Physics Group* is that, unless more flexibility is demonstrated than has been in the past, we will have a system that, by requiring all entrants to the profession to undertake a rigid training scheme, will make it impossible to bring in from academia or industry physicists with new skills. The barrier to such people entering the profession will be whether they are eligible for registration with the *Health Professions Council,* a statutory requirement. At the moment there is a route to registration that addresses that issue and does not require people to undertake the formal training programme while, at the same time, ensuring that they have the same skills and experience as those who do. Ironically, at the moment anyone undertaking the new MSC training will not be eligible for registration although it is expected that this will be resolved before these people complete the 3 years of training.

There is much in the MSC programme that is good but also much that has not been thought through. This is reflected in the fact that, for the moment physicists in Scotland will continue to be trained under the old system. The existing training programme is recognised as delivering the workforce that Scotland needs and they intend to explore how they can adapt it to ensure that it is aligned with MSC, retaining the flexible routes to registration, rather than simply adopting a new, untried, and, possibly, more expensive training programme.

Prof. Peter F. Sharp
Bio-Medical Physics & Bio-Engineering
University of Aberdeen & NHS Grampian

ISMRM 2010, 1st–7th May 2010, Stockholm, Sweden

This year I attended the conference for the *International Society of Magnetic Resonance in Medicine* (ISMRM) in Stockholm, Sweden. The ISMRM brings together researchers from a wide range of disciplines; including physicists, engineers, computer scientists and clinicians. There are around 6000 attendees and the conference lasts six and a half days.

The first two days are given over to the *Educational Weekend,* where experts hold a host of lectures on a wide variety of topics. These introduce the techniques and give the theory behind them. Several parallel sessions run allowing for topics ranging from *MR Physics, MR Safety and Cancer Imaging* to be covered. These give people new to the field an excellent introduction, and with ample opportunity to ask questions it is very helpful.

The next five days are used for the *presentation of papers, with posters, electronic poster presentations and talk sessions* being held. There were also sessions for debates of *"hot topics"* such as *"Will 7T ever go clinical?".* With approximately 2000 posters, it can be overwhelming but they are a great way to discuss the work. This is very helpful as you can learn about different methodologies and approaches to a problem or to obtain advice as to how best to use a new technique. Also as the presenter, advice can be given on how to solve a problem you may have been having with your work.

I presented a talk and three posters during the week; this gave me an excellent opportunity to talk to researchers in my field. Allowing for ideas to develop my own work and to see what is being done at different labs worldwide.

Apart from the scientific sessions there were plenty of *social events* to get to know people from different labs. The ISMRM hosted an evening at the *City Hall* in central Stockholm so that students could meet established researchers. The City Hall is where the meal for the Nobel Prize winners is hosted, so we were all hoping that we might be back there some day! The closing ceremony included an *ABBA tribute band* and was a fun way to close the conference.

Emma L. Hall
Sir Peter Mansfield Magnetic Resonance Centre
University of Nottingham

RADAM 2009 Conference, 1st–4th July 2009, Frankfurt, Germany

This event was the sixth in the RADAM series of conferences, which primarily involve scientists working on the *interactions of electrons, ions and photons with molecular targets,* with a focus on attempting to fully understand the interactions of ionising radiation with biological material. The applications of this knowledge are numerous, but probably the most important is the *health-related aspects*, both in terms of radiation as a therapeutic agent for the treatment of cancer, as well as a potential environmental hazard. The conferences have proved highly successful, continuing well beyond their original four-year action plan and bringing in scientists from many different fields.

This year's event was no exception, with attendees ranging from theorists and experimentalists working on the fundamental interactions of individual particles and molecules, through studies on radiation effects in more complex biological systems, up to those working on human-scale radiation protection for space science and clinical trials for novel therapeutic techniques such as the heavy ion radiation facility at GSI.

There were numerous very interesting talks, showing the substantial contribution that physics can and is making to the field of radiation biology. One particularly exciting application was outlined across several talks by delegates from the *GSI facility* focusing on their work on the *use of heavy ions (particularly carbon) to treat cancer,* which appears to have the possibility to substantially increase the quality of treatment for numerous classes of cancer – with successful treatment rates as high at 90% compared to less than 30% for traditional therapies. In addition, there was a talk on the development of the new *Heidelberg Ion Therapy centre* which will be a dedicated centre for the *treatment of cancer patients with proton, oxygen and carbon ion based radiotherapy,* beginning to treat patients this autumn, which we had the great opportunity to tour after the conference.

On the theoretical front, there is increasing interest in fully mapping out the series of interactions leading from the arrival of ionising radiation to the eventual damage to DNA. In most current applications a value of *"dose"* (that is, deposited energy) is calculated whose eventual relation to damage is empirically determined by experiment. However, with increasing computational power it is becoming possible to more completely *map out the effects of radiation on the level of individual molecules,* which offers a tremendous potential to improve our understanding of the effects of radiation, and potentially how we can modify it to increase the effectiveness of radiotherapy.

This is the area of particular relevance to my work, as I am investigating the *effects of gold nanoparticle contrast agents*, which offer the possibility of substantially increasing the dose deposited in tumours while sparing healthy tissue. Early experiments have shown that the traditional approach of simply considering dose do not give an accurate picture of the effects of these particles, and so a better understanding of the underlying interactions is necessary to accurately predict how best to use these particles to improve the quality of treatment.

As a result, many of the talks at this meeting were of great interest as they provided many useful ideas and models which may be able to inform the future development of our understanding of this system. In addition, there was also substantial interest in the content of my presentation on the current state of our modelling of the interaction of gold nanoparticles with radiation, as they are an exciting prospect for radiotherapy dose enhancement, with numerous groups beginning to study their interactions with various different forms of radiation.

All in all, it was a very useful conference, which will likely be very valuable in informing future work within our group, and I would like to thank the *IOP Medical Physics Group* for helping me attend it.

Stephen McMahon
Queen's University Belfast

Thirty Five Years of Collaboration in Medical Physics

Swansea University, founded by Royal Charter in 1920, shares the picturesque setting of Singleton Park overlooking Swansea Bay with *Singleton Hospital,* a major teaching hospital providing cancer services for the whole of Southwest Wales. This physical proximity has naturally led to close contacts between the two institutions, which in the case of Medical Physics has resulted in a long-standing and fruitful collaboration in research and teaching.

Initial contacts between the *Physics Department at Swansea University* (SU) and the *Department of Medical Physics and Clinical Engineering* (MPCE) at *Singleton Hospital* were established through undergraduate projects on computerisation of radiotherapy treatment planning. These early contacts led to the establishment, in 1976, of a collaborative research group which came to be known as *Swansea In Vivo Analysis Research Group* (SIVARG).

The objective of this group was to develop physics-based methods for the in vivo determination of body elements and body composition and to deploy them clinically. The first directors of SIVARG were *Dr David Phillips-Miles* of the West Glamorgan Health Authority, *Mr Arthur Sivyer,* Head of MPCE at Singleton Hospital and *Professor Jack Dutton*, Professor of Physics at SU. In this way, the close collaboration of clinicians and medical physicists from the NHS with physicists from the University was ensured from the beginning.

The group obtained financial support, initially, from the Welsh Office through the Welsh Scheme for the Development of Health and Social Research (WSDHSR) and from the then Science and Engineering Research Council through the award of CASE research studentships. These enabled the group to develop prototype systems for the in vivo detection of heavy metals in the body and apply them to clinical projects such as the investigation of possible links between smoking, hypertension and cadmium exposure, for example.

After obtaining general support and encouragement from joint discussions between members of SIVARG, the College Officers and the Chief Medical Officer and his colleagues at the Welsh Office, application was made to the *Medical Research Council* (MRC) for financial support for the next phase of the research and this resulted in the award of three inter-related Project Grants for the *development of three technically sophisticated clinical systems, based on neutron activation, x-ray fluorescence* and *neutron inelastic scattering,* for the in vivo analysis of both major and trace elements within the human body.

In parallel with these developments, a successful application was made to the *Wellcome Trust* for the establishment of a Wellcome Trust Lectureship in Magnetism Applied to Medicine. This enabled SIVARG to extend its research expertise into other areas, such as *magnetopneumography for the in vivo assessment of particulate lung contamination, and SQUID susceptometry for non-invasive determination of hepatic iron levels.* Further development of SQUID-based instrumentation at SU has led to a versatile and portable system for fetal heart monitoring. Closely related was the development of an electromagnetic method for the measurement of body water and body fat which was made possible through further Welsh Office support from the WSDHSR scheme.

The SU submission to the Welsh Office in 1986 for the establishment of a School of Postgraduate Studies in Medical and Health Care strongly supported its case by quoting the existing links between SU and the NHS and inter alia stated that: "Probably the most well developed local collaboration to date is the Swansea *In Vivo* Analysis Research Group (SIV ARG). This group already perceives the need for a medical research presence within the School, which will provide supervision of medical postgraduate personnel involved in clinical projects utilising the new powerful and sophisticated techniques which are now at an advanced stage of development. In addition to the stimulus provided by the close interaction between College and Medical Staff within the proposed school, the existence of a high level of expertise in sophisticated technologies existing within the College can be of considerable help to the general medical services of the region if it can be focused through the School".

The acceptance of the case by the Welsh Office and subsequent establishment of the School did indeed lead to the envisaged increased interaction between SIVARG and the local medical community and thus to many clinically worthwhile projects. These are reported in over 100 papers published by the group in scientific journals, and in the book entitled *"The Swansea Trial".* The project was a collaborative one organised by *Drs Alan Howard and Stephen Kreitzman* of the Howard Foundation Research, Cambridge and involving Addenbrooke's Hospital, the University of Liverpool and SIVARG. The project concerned the changes in *body composition resulting from Very Low Calorie Diet.* It utilised a wide range of the existing SIVARG modalities and in a foreword to the book, *Lord Butterfield* (formerly Head of the Clinical School, University of Cambridge) expressed the view "that the Swansea Trial has greatly changed the whole intellectual climate in the field of obesity research and I not only commend the team involved for their efforts but also this book report for its impact".

Close research collaboration between MPCE and SU has continued to the present and has resulted in more than 30 jointly supervised PhD projects. Both current Heads of Radiotherapy and Nuclear Medicine Medical Physics services at Singleton Hospital received their PhDs for research carried out on early SIVARG projects. Many other MPCE and SU personnel are also SIVARG graduates.

On the teaching side, a successful *"Physics with Medical Physics"* BSc degree was offered in Swansea for many years. The *MSc in Medical Radiation Physics,* accredited by IPEM as a Clinical Scientist training route, has been running at Swansea since the 1980s and has more than 50 graduates. In 2008 *Dr. Richard Hugtenburg* was jointly appointed by the University and the NHS (on a half academic, half clinical contract) to lead this MSc course, which is delivered by both MPCE and SU staff. This appointment and plans for further recruitment of clinical science academics strengthen the existing links in Medical Physics between MPCE and SU and set a valuable precedent for the future. Dr. Hugtenburg's research includes the modelling and design of high-resolution, solid-state dosimeters for the monitoring of small-field and intensity-modulated radiotherapy.

In 2001, with funding from the Welsh Assembly Government, the *BSc in Clinical Technology* degree scheme was launched at Swansea University. This four-year degree scheme (now accredited by IPEM) combines academic modules, taught at the University, with hospital placements and trains its graduates to the level sufficient for direct entry into the *Voluntary Register for Clinical Technologists.*

A recent funding innovation to emerge at the post-graduate level is a five year programme of grants supporting domestic and European-origin students studying towards an M.Sc. The premise of the programme is to *link students with local industry sponsors,* providing dissertation project supervision. Students on the MSc in Medical Radiation Physics have worked with Swansea companies developing miniature heart-pumps, intense pulsed light (IPL) devices for hair removal, stem-cell cytometry, and novel use of MRI for structural analysis in disease.

With the expansion of cancer services based at MPCE, and the substantial support for clinical and health-related areas at SU, as recently evident from the success of the Institute of Life Science (ILS) there are even greater possibilities for collaboration in Medical Physics on the horizon. Construction of a *second research institute,* ILS2, is currently under-way which is planned to host a range of *high-tech physics and engineering-based projects, including nanotechnology in medicine and CT and MRI facilities for clinical research*. Swansea is destined to remain a showcase for a successful symbiotic relationship between academia and the NHS.

Dareyoush Rassi
College of Human and Health Sciences
Swansea University

KTN meeting on "Position Detectors for Physics, Medicine and Security"

Hamilton House, Euston, London, 12th May 2010

The *Research Instrumentation Group* (RIG) is one of the *Knowledge Transfer Networks* (KTN) run by the Technology Strategy Board, which aims to promote innovation in the UK. KTN's are national network that act as open forums (participation is free of charge) in specific fields of technology or business applications, which brings together people from businesses, universities, research, finance and technology organisations in order to stimulate innovation through knowledge transfer and sharing of ideas. RIG aims to improve UK industry engagement with UK universities and international research facilities by brokering partnerships and collaborative R&D projects.

A KTN meeting on *"Position Detectors for Physics, Medicine and Security"* was organised by RIG's subgroup on *Sensors & Instrumentation,* as a platform for the high energy physics, security and medical sectors to interact. The meeting tried to explored synergies between high energy physics, security and medicine applications, especially in the use of advanced position sensitive radiation detectors, through a series of talks by invited speakers.

The meeting started with a welcoming address by *Oliver Stigley,* who explained the mission, structure and activities of the Sensors & Instrumentation KTN. The subsequent talks were organised in 3 sessions covering the speaker's perspective, i.e. a technology provider or user, as well as demonstrators of technology transfer.

The *"Users Perspectives"* session started with *Prof. Phil Allport* of Liverpool University, who provided a comprehensive report of the "state of the art" position detector technology used in particle physics. Then *D. Ed Morton* of Rapiscan systems presented needs in security applications, e.g. baggage scanning, and the implications on detector technology. Apart from improvements in image quality (contrast, resolution) the ability for material identification as a means to identify explosives was made evident. *Dr. Phil Evans* from the Institute of Cancer Research presented on the perspectives of a detector user in healthcare, showcasing the use of imaging detectors in radiotherapy. A number of different purposes were identified, like the correct diagnosis and visualisation of the extent of the disease, patient positioning during treatment and treatment verification, all aiming to maximise the therapeutic gain with the minimum amount of radiation dose. Detector requirements, however, differ depending on the imaging technique used, e.g. PET or SPECT or dose distribution measurement of MV X-Rays.

The next session had presentations from *technology providers. Dr Cliff Weatherup* from e2V Ltd. presented examples from the company's extensive portfolio on imaging sensors, CCDs and more recent CMOS, predominantly used in astronomic applications. The impressive evolution of sensors size and resolution was demonstrated with the number of pixels from around 1M pixels for a 1990 sensor to more than 100M pixels nowadays, with future missions planning to use sensors with 1B pixels! Examples were also shown in improvements in quantum efficiency across the optical spectrum and beyond, as well noise reduction, e.g. less than 4 e for at 1 MHz readout. *Keith Barnes* from Salex Galileo presented Infrared detectors used in security, scientific and industrial applications. The typical sensor structure was of a 2D detector array (from CdHgTe on GaAs substrate) to be bump bonded to a matching 2D array of an electronics read-out chip. Once again there was a need for increased spatial resolution and read-out speed as well as noise reduction and improvements in quantum efficiency. The final talk of the session was from *Glenn Tyrell* from Applied Scintillation Technologies Ltd., who presented the company's development on position sensitive scintillators. These were Tl doped CsI scintillating crystals grown in a columnar format and coupled to an imaging device (CCD or CMOS 2D arrays), normally used in X-ray radiography. Examples were also shown scintillators for neutron imaging.

The last session of the day was on *experience with "real life"* from cases demonstrating detector technology transfer, academic innovations and technology push. *Dr. Jaap Velthius* from Bristol University talked about techniques used in high energy physics experiments for charge particle tracking and the possibility of transfer them for medical applications. Examples were given by using Monolithic Active Pixels Sensors (the scientific variant of CMOS sensors) in radiotherapy for the measurement of 2D dose distributions in real time. *Dr. Spyros Manolopoulos* from the radiotherapy department of University Hospital in Birmingham presented his work on using high energy physics detectors (Si microstrip) for dosimetry measurements in stereotactic radiosurgery. This was the result of the first project to be commonly funded by STFC's predecessor (CCLTC) and the Department of Health (project DOSI) with its results presented in international conferences and peer reviewed scientific journals, like Medical Physics and Physics in Medicine and Biology. DOSI was shown to help improving the radiotherapy services provided by UHB by enabling the use of smaller stereotactic beams, make it possible to treat even smaller lesions. *Mr. Paul Seller* presented on detectors and electronics developed at STFC. Finally, *Dr. Andy Boston* for Liverpool University presented on various projects that transferred detector technology (segmented HpGe and CZT) from Nuclear Physics (gamma ray tracking; AGATA collaboration) to applications in medicine (SmartPET/ProSPECTus), the environment (decommissioning, PorGamRays) and safety (drugs and explosives).

The day concluded with time for discussions and networking, as well as time to visit exhibition stands of industrial vendors: *Hamamatsu, Higher Crystals, Dexela, Sens-Tech Ltd. and Applied Scintillation Technologies.*

Links

www.innovateuk.org/

https://ktn.innovateuk.org/web/research-instrumentation/position-detectors-event

Spyros Manolopoulos
University Hospitals Birmingham NHS Foundation Trust

MPG Committee Contacts

Chair
Dr. Colin Baker
Email: colin.baker@liverpool.ac.uk

Treasurer
Dr. Dareyoush Rassi
Email: D.Rassi@swansea.ac.uk

Secretary
Dr. Mairead Butler
Email: m.butler@ed.ac.uk

Newsletter Editor
Dr Dimitra Darambara
Email: dimitra.darambara@icr.ac.uk

This newsletter is also available on the web and in larger print sizes

The contents of this newsletter do not necessarily represent the views or policies of the Institute of Physics, except where explicitly stated.

The Institute of Physics, 76 Portland Place, W1B 1NT, UK.

Tel: 020 7470 4800
Fax: 020 7470 4848