IOP Institute of Physics

Medical Physics Group

2017 - 2018

Farewell to our committee chair Dimitra Darambara

For more than a decade Dr Dimitra Darambara has served the IOP Medical Physics Group as both an ordinary member and then as the chair. In March of this year, after serving four years as elected chair and two years as interim chair, she stood down. Dimitra has been a driving force on the Medical Physics Group committee and we are sad to be without her leadership, albeit that she will remain co-opted to the committee through the transition period of breaking in our new chair.

Dimitra has not only been a driving force in the medical physics group, but also across the Institute where she has held a number of key roles including as a member of Groups Committee. She is passionate about medical physics, science policy, diversity and the profile of professional physicists. She has been instrumental in ensuring that academia, the NHS and the healthcare industry have a voice in medical physics, and are represented at the Institute level and in Central Government.

As committee members we shall miss her encyclopaedic knowledge of the inner workings of the IOP, her role as an ambassador to the plethora of other learned and professional bodies in medical physics, biophysics and medical engineering in the UK, and the passion and energy that she brought as the chair of the committee. However, as a committed member of the group, we expect to continue to see her at many of the group events where we know she will continue to be an active contributor.

Dimitra, as a committee we thank you for all of your time and efforts and wish you all the best for the future!

New Medical Physics Group PhD Thesis Prize

The IOP Medical Physics Group (MPG) launches a new annual prize for the best PhD thesis to recognise outstanding graduate students in the field of medical physics. Any thesis submitted as part of a PhD programme of study at a university in the UK and Ireland in the two years prior to the application is eligible for consideration. The winner will be selected by a subset of the group committee. It is a condition of the award that the applicant, if not already an MPG member, will join the Group at the time of applying.

Keep an eye on our webpage for details.

CONTENTS

IOP Medical Physics Group

We are in Twitter! Follow us for the latest medical physics news!

@IOPMED

PAST IOP MEDICAL PHYSICS MEETINGS

Medical Physics Group: Symposium for Early Career Physicists

IOP London, 10 November 2017

The MPG Group held a symposium for early career physicists to promote career development and networking opportunities. The meeting targeted those at an early stage of their careers in the field of physics as related to medicine, changing career path and returning to their careers after a break. The meeting combined technical talks by early career physicists, with open panel discussions and a question and answer session; providing opportunities for networking across the breadth of medical physics and

Read Klaudiusz Jakubowski's experience at this meeting on page 6.

Up and Coming Techniques in Medical Physics Translated into Clinical Practice, IOP London, 8 December 2017

The 5th MPG annual meeting brought together people from diverse areas of medical physics to discuss the translation of innovative developments and new technologies into clinical practice and the associated challenges. Talks from experts included topics such as Raman scattering microscopy to monitor drug delivery, CT subtraction imaging, portable hybrid gamma-optical imaging and photon counting with X-ray detectors.

MRI and its history

University of Nottingham, 18 April 2018

This meeting was organised by the History of Physics and Medical Physics and Magnetic Resonance Groups and celebrated the invention of the technique of Magnetic Resonance Imaging (MRI) by Sir Peter Mansfield in Nottingham in the 1960s, for which he shared the Nobel Prize for Medicine in 2003. The presentation included historical talks on the early days of NMR (Nuclear Magnetic Resonance) in Britain, on the work at Aberdeen leading to MRI, and on the work of Mansfield and others at Nottingham in the 1960s.

Towards Terahertz Imaging of Cancer

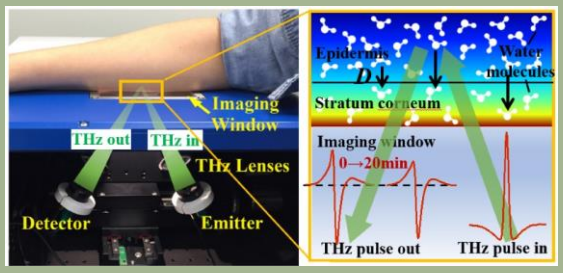
IOP, London, 12 July 2018

The Instrument Science and Technology and Medical Physics Groups organised a meeting to discuss the latest THz imaging technology and the potential requirements for translation into a clinical tool for cancer diagnosis.

Read the meeting report from Tami Freeman in Physics World:

THz technology: a new take on cancer imaging

https://physicsworld.com/a/thz-technology-a-new-take-on-cancer-imaging/



(Courtesy: Emma Pickwell-MacPherson)

PAST IOP MEDICAL PHYSICS MEETINGS

Photon 2018

Aston University, Birmingham, 3-6 September 2018

Photon is the major optics and photonics conference organised by the IOP in the UK and the ninth in the biennial series that started in 2002. Over four days, participants had the opportunity to visit exhibitions on the latest in optics and photonics technology, attend lectures from experts in the field, and get up to date with cutting-edge research. The Medical Physics Group organised two sessions dedicated to 'Medical Applications of Light', chaired by Dr Karen Hampson and Dr Phil Marsden from the MPG, with invited speakers Katjana Ehrlich from Heriot-Watt University discussing *Fibre-based sensing of physiological parameters with time-resolved single photon spectroscopy* and Prof. David Sampson from the University of Surrey describing *Optical coherence tomography ographies and their applications*.

Follow this link for more information. #IOPPhoton18

UPCOMING IOP MEDICAL PHYSICS MEETINGS

Towards Gender Equality in Physics – What is Medical Physics Getting Right?

IOP, London, 12 November 2018

The Women in Physics Group and the Medical Physics Group invite you to this meeting celebrating and reviewing progress towards gender equality in medical physics, identifying that it is one of the few areas of physics where gender parity is being approached. We will hear from female medical physicists in the NHS, academia and industry, before discussing what it is about medical physics that fosters greater gender equality and whether these features can be used to inform diversity strategies within other fields of physics and STEM more generally.

Speakers will include:

- Prof Francis Duck: *A history of women in physics.*
- Prof Penny Gowland, The University of Nottingham: *Medical physicists in academia.*
- Ursula Johnson, University College London Hospitals: *Medical physicists in the NHS.*
- Dr Giulia Thompson, Elekta: *Medical physicists in industry.*

The afternoon will consist of small group discussions.

For more details contact: Heather Williams from the Women in Physics Group (h.williams@christie.nhs.uk) or Ana Denis-Bacelar from Medical Physics Group (ana.denisbacelar@npl.co.uk).

Up and Coming Techniques in Medical Physics Translated into Clinical Practice - NPL, Teddington, London, 10 December 2018

The 6th annual meeting of the Medical Physics group will be sponsored by the new centre for Metrology in Medical Physics at National Physical Laboratory and will be focus on measurements sicence to clinical practice in various areas of medical physics.

For more details contact: Ana Denis-Bacelar (ana.denisbacelar@npl.co.uk) or George Corner (g.a.corner@dundee.ac.uk)

MEETING REPORTS

25th International Society for Magnetic Resonance in Medicine (ISMRM) meeting, 22 – 27 April 2017, Honolulu, Hawaii, USA

Thanks to an IOP travel grant, I attended the 2017 Annual Meeting of the ISMRM. This is a unique opportunity for researchers, clinicians and companies working in the field of Magnetic Resonance (MR) to meet, communicate and share their knowledge. During the first two days, education was the primary focus of the Meeting. A broad range of courses was available, in which fundamental aspects of MR techniques and applications were explained by experts in their field. There were still some educational sessions during the rest of the conference but most of the sessions were dedicated to the presentation of original research. In addition, leading companies and manufacturers in the MR sector showcased their products in the exhibition and poster hall. This was a great chance to appreciate the industrial side of MR imaging. Throughout the meeting there was also the opportunity to attend social events organised by the Society or its corporate members. These were further occasions for meeting and discussion in a friendly and informal environment.

My personal experience fulfilled all my expectations. During the first two days of educational sessions I reviewed the basic physics principles of MR imaging, the cutting-edge techniques for vascular MRI in the brain and the state-of-the-art for the quantification of magnetic and electrical properties of tissue. During the following four days, I presented two pieces of original work from my PhD project: Evaluating the Accuracy of Susceptibility Maps Calculated from Single-Echo versus Multi-Echo Gradient-Echo Acquisitions and Susceptibility Mapping Reveals Inter-Hemispheric Differences in Venous Density in Patients with Brain Arteriovenous Malformations. I received helpful comments on a technical problem I encountered during my MR experiments, an artefact that I had been seeing randomly in the images I acquired for my study on brain Arteriovenous Malformations. A researcher in the same susceptibility mapping field suggested that this error might be due to failure of a specific imaging parameter to function as expected. I now aim to remove these artefacts by applying a post-hoc correction method to my images, and I expect this to improve the accuracy of my measurements of magnetic susceptibility. In addition, I received advice on which clinical questions to address with my project on brain Arteriovenous Malformations.

During the remainder of the Meeting, I participated in the useful and relevant meeting of the Electro-Magnetic Tissue Property Study Group, of which I have been elected trainee Representative for the year 2017/2018. The conference featured several excellent speakers. I particularly enjoyed the closing plenary lecture dedicated to Sir Peter Mansfield, who was awarded the 2003 Nobel Prize in Physiology or Medicine for his pioneering work on MRI and sadly died earlier this year. The Mansfield Lecture was given by Penny A. Gowland, Professor of Physics at Nottingham University, who had been working closely with Sir Peter Mansfield since her time as a PhD student. Prof Gowland talked about her career dedicated to pioneering MRI methods for “things that move”, such as the gastrointestinal system and the foetus. I found the lecture interesting from a scientific perspective, but also truly inspirational due to the speaker’s constant references to Sir Peter Mansfield’s legacy.

Overall, I truly enjoyed the conference. I would recommend that anyone with an interest in MRI attends this conference.

Emma Biondetti

PhD student at UCL

@EmmaBiondetti

http://www.ucl.ac.uk/medphys/research/mri

MEETING REPORTS

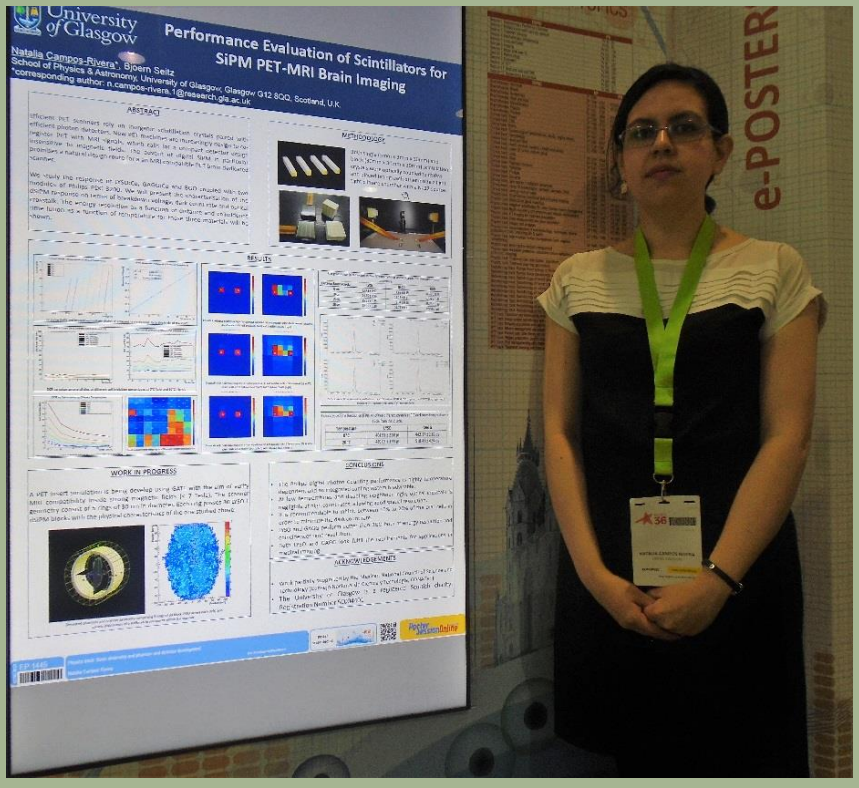
36 European Society for Radiotherapy and Oncology (ESTRO) meeting, 5 – 9 May 2017, Vienna, Austria

I attended the ESTRO 36 at Vienna, Austria, from May 5 to 9, 2017 with more than 5000 participants. This conference represents the annual scientific meeting of the European Society on Translational Radiotherapy and Oncology and brings together physicists and clinicians from all over the world to share state-of-the -art research aiming to detect and treat cancer or to improve current practices in the oncological field.

The programme of the event not only covered teaching lectures but also discussions and networking spaces. For me, the two main sessions were the "Young Scientists Program" and the debates about "The Future of Radiotherapy". The first one had for goal to guide early scientists in their career, teaching us how to write and review papers and to take advantage of all the resources available in Europe. Additionally, we had a met up with the editors of three radiation oncology journals from ESTRO (ctRO, phiRO, tipsRO), that re-enforced the material taught during the lectures. On the other hand, the debates were extremely interesting with topics from the gaps in available resources to treat cancer among all country members of Europe to the dream of having computer-based medical tools with minimal intervention of humans, covering the lack of a homogenisation as well of the educational requirements in the clinical practice. My favourite was the forum debate on how to bring the ESTRO 2020 mission from a physicist's perspective.

Finally, the networking opportunities were endless, principally at the exhibition centre where people from the industry showed the new equipment and gadgets available for our field. Additionally, this year was the highest attendance to the ESTRO, from PhD students to awarded researchers.

Overall, I feel that my attendance to this event was a success, I met people for my network but also for my department and I was able to discuss my work with experts in the field just a few months before the end of my doctorate recommend that anyone with an interest in MRI attends next year's meeting in Paris, France.



Natalia Campos-Rivera *is a PhD student at the University of Glasgow*

http://nuclear.gla.ac.uk/

MEETING REPORTS

Society for Neuroscience meeting

11 – 15 November 2017, Washington DC, US

***Niraj Sharma** finished his PhD at UCL and is now a Data Scientist at Rakuten Fits*

The Society for Neuroscience meeting attracted nearly 30,000 delegates and took place over five days. During the conference I was exposed to many interesting talks in the different areas of Neuroscience and was able to set up potential collaborations with other researchers in a similar field. Of particular interest was the talk by Demis Hassabis, co-founder of Google Deepmind, on the use of artificial intelligence to solve real world problems. My research also entails artificial intelligence. Therefore, this further broadened my mind on the other different uses I can use the skills I have learnt and apply them to other areas of Neuroscience research.

During my poster session I was able to communicate my ideas to a broad range of academics from PhD students to Professors. Many people were interested in the algorithm I designed that automatically classifies epileptic spikes with a particular interest from the Gyorgy Buzsaki lab; a leader in the field of electrophysiology. I was able to set up collaboration with research scientists with Yale and hopefully to carry on collaborating with them after I have finished my PhD. I was also made two offers from different labs for potential post-doctoral positions that I hope to follow up on. Attending the annual meeting provided me with outstanding educational opportunities and gave me the possibility to present my findings to leading experts in the field, which represented an invaluable occasion for my personal and professional growth. I could not be more grateful for the financial support received by the Institute of Physics which proved fundamental in allowing my attendance.

Medical Physics Group: Symposium for Early Career Physicists

10 November 2017, IOP, London

***Klaudiusz Jakubowski** is an MSc student at the Uniwersytet Śląski w Katowicach, Poland*

I was very lucky to attend the IOP symposium for early-stage medical physicists. It clearly widened my understanding of medical physicist's career. It, helped me decide what I want to do in my career. It was a great opportunity to meet new people in this particular field of science, broaden the network which is extremely important and gain experience of attending such events. The conference was carefully prepared and that fact made it intensive, fulfilled with new information of a different kind. It was an amazing chance to listen and to talk about current possibilities for medical physicists along three paths: academia, industry and clinic as well as to hear about new undertaken research in this area. Interestingly, all presentations were conducted by scientists from all three pathways which was unique, varied and even more interesting. Furthermore, we could find quite a few brochures describing topics such as „is worth to do a PhD". Every presentation ended up with an open debate so everyone could ask whatever was necessary to know. The age range of participants varied a lot, therefore, surely, mentioned issues were about something that you would not think of straight away. Participants and lecturers were very open to talk and share their experience. I can definitely recommend the IOP events will attend again as long as I will have a chance. According to the attitude of the organizers, the main target of the IOP events is to keep developing, make sure to talk about every single case and guarantee that the participant can bring back home as much as it is and possible. Thank you, IOP!

OTHER CONFERENCES

Medisens – The European Medical Imaging Conference

Royal Marsden Hospital, London, 26-27 February 2018

Members of the IOP Medical Physics Group, Dimitra Darambara (The Institute of Cancer Research and The Royal Marsden Hospital NHS FT), Ana Denis-Bacelar (National Physical Laboratory) and Phil Marsden (Unitive Design) discussed the latest technologies in development in the field of medical imaging at the Medisens conference. The event brought together academic, industrialists and clinicians to discuss the unmet needs in imaging, both from a diagnosis and treatment perspective.

Day one focused on imaging in diagnosis, with highlights including new developments in photon-counting computed tomography; PET/MR and hybrid imaging, plus; NHS England's view on the wider issues of AI and Deep Learning. Day two focused on therapy planning, with a keynote address from Professor Uwe Oelfke, Deputy Head of the Division of Radiotherapy and Imaging at the ICR and RMH, and insights on imaging requirements from proton therapy pioneer Dr Tony Lomax.

Applications of 3D printing for medical phantoms workshop

National Physical Laboratory, 28-29 September 2017, Teddington, UK

On the 28th and 29th of September, the National Physical Laboratory (NPL) organised and hosted a two-day workshop on "Applications of 3D printing for medical phantoms". The workshop was supported by Institute of Physics and Engineering in Medicine (IPEM) and NPL Metrology for Medical Physics (MEMPHYS) with the aim of exploring needs and advantages of additive manufacturing for medical phantoms.

The workshop was attended by over 80 delegates, attracting experts in the field as well as newcomers. It created a stimulating environment for discussion and development of potential collaborations and links between 3D printing manufacturers, academic and clinical communities.

Invited talks were given by Prof. Uwe Oelfke (ICR), Dr Ehab Saleh (University of Nottingham), Dr Aaron Oliver-Taylor (Gold Standard Phantoms), Dr David Sinden (NPL), Dr Nick Calvert (The Christie NHS Foundation Trust) and Dr Chris Cawthorne (University of Hull). Sessions included talks on printing techniques, advances in 3D printing and modality specific phantoms (MRI, molecular radiotherapy, external radiotherapy, Ultrasound).

Nottingham University

3D Life Prints


Patient specific phantoms
Christie Hospital

Giuseppe Schettino and Andrew Robinson

NPL, Chemical, Medical and Environmental Division

All presentations are available on the website.

MEDICAL PHYSICS NEWS

NPL launches Metrology for Medical Physics Centre

The National Physical Laboratory (NPL) is the UK's National Measurement Institute and is a world-leading centre of excellence in developing and applying the most accurate measurement standards, science and technology. In response to the rising healthcare challenge in the UK, alongside key objectives laid out in the Industrial Strategy Green Paper (2017) and the Accelerated Access Review (2016), NPL launched a new Metrology for Medical Physics Centre (MEMPHYS).

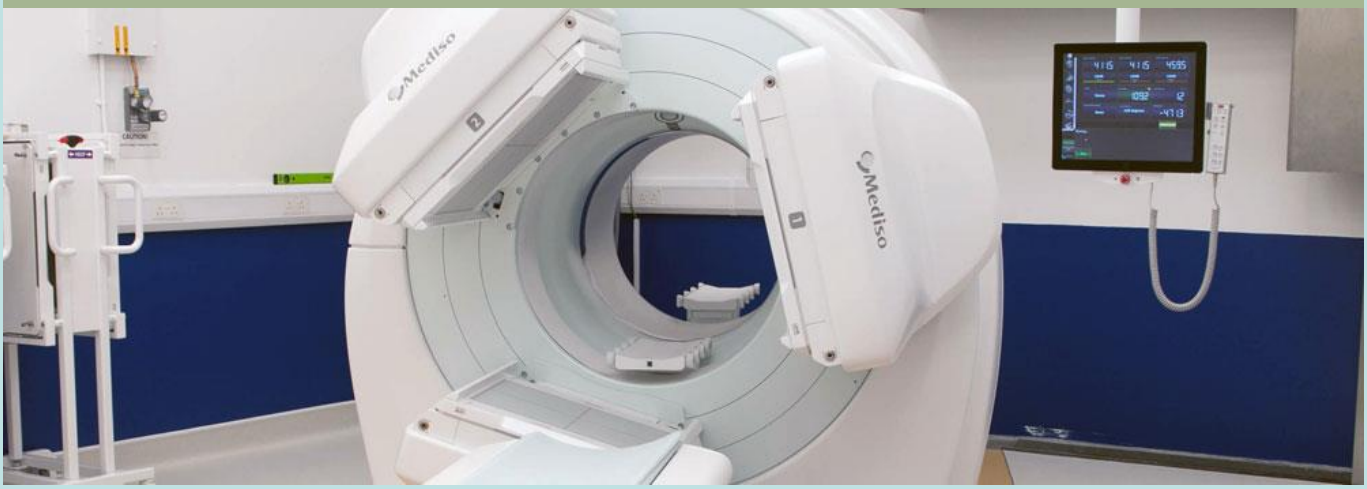
MEMPHYS will support rapid acceleration for the development and implementation of innovative early diagnostic and therapeutic technologies, for conditions such as cancer, dementia and heart disease into clinical practice. Advanced technologies currently undergoing development in the UK, which will benefit from the Centre's support include:

- **Advanced radiotherapy delivery systems** - the Centre's collaborative research and expertise will enable more accurate and targeted radiotherapy treatments through the provision of end to end treatment verification methodologies, protocols and training.
- **New imaging technologies** – the Centre will help to establish a framework for quantitative imaging that will support medical image decision making, leading to earlier diagnosis and improved treatment of conditions such as cancer, dementia and heart disease, with the potential to significantly reduce unnecessary costs and procedures.
- **Radiotherapeutic drugs** – the Centre will pave the way for new radiotherapeutic research and drug trials which will seek out and target tumour sites with radioactive isotopes to irradiate a focussed region around the tumour – ensuring a more personalised treatment.
- **Proton beam therapy (PBT)** – with public and private centres coming online in the UK in the next year, the Centre will help to ensure that PBT is delivered to the same level of accuracy as conventional radiotherapy so maximising treatment efficacy and realising the full potential of this more advanced form of radiotherapy.
- **Rapid Phantom Prototyping Laboratory** – The Centre will house a new 3D printing facility which will focus on producing and optimising the use of medical phantoms. Phantoms can provide more consistent results than the use of a living subject or cadaver, and provides an opportunity to reduce the number of animals used in biomedical studies.

NPL will undertake research and share expertise with government, business and the health service to help enhance healthcare and improve quality of life for patients in the UK and across the world. This new approach will see NPL focus on tackling some of the world's biggest health challenges, from supporting the diagnosis and treatment of diseases such as cancer and dementia, to drug efficacy evaluation.

Rebecca Nutbrown
Head of Medical Physics Metrology

NPL



IOP NEWS

IOP Business Awards for Individuals

Awards for individuals in business – Call open Oct 2018 to Jan 2019

These are the IOP's prestigious medals and prizes awarded to an individual's contribution to the application of physics in an industrial, commercial or business context:

- The Katharine Burr Blodgett Medal and Prize is awarded for outstanding and sustained contributions.
- The Denis Gabor Medal and Prize is awarded for distinguished contributions.
- The Clifford Paterson Medal and Prize is awarded for exceptional early career contributions.

Early Career Physics Communicator Award

Prize objectives and scope

The IOP Physics Communicators Group invites applications from people at the start of their careers in physics who have undertaken activities that support and encourage excellent communication of physics.

Eligibility

Applicants do not need to be a member of the IOP but must be resident in the UK or Ireland and either within five years of a first degree in physics or currently engaged in postgraduate study in physics.

The Prize

The winner of the 2018 IOP Physics Communicators Group Award will receive £250 and an award certificate at an event to be held on 23rd of November 2018. As well as providing recognition of the winner's work, the process will also facilitate networking opportunities for all shortlisted finalist

The application submission deadline is on Monday 1st of October 2018. For more information:

http://www.iop.org/activity/groups/subject/physcom/prize/page_50554.html

IOP Research Student Conference Fund

The Institute of Physics provides financial support to research students to attend international meetings and major national meetings. The Institute of Physics (IOP) handles the application process but it is the relevant IOP group that makes the decision on whether to award the bursary and its value.

Am I eligible?

Research Student Conference Fund (RSCF) bursaries are available to PhD students who are Member of the Institute and joined an appropriate Institute group.

What is the bursary worth?

Students may apply for up to £300 during the course of their PhD. Groups have limited funds to award bursaries and so students may not receive the full amount they have requested. If the full amount is not awarded students may apply again to receive further support for a different conference until they reach £300 overall. Note that grants will normally cover only part of the expenses incurred in attending a conference and are intended to supplement grants from other sources.

How can I apply?

Application details and application form.

RSCF applications are considered on a quarterly basis and should reach the Institute by: 1 March, 1 June, 1 September or 1 December; a decision will be made within eight weeks of the closing date.

For further information, please contact:
supportandgrants@iop.org

JOURNAL SPOTLIGHT

Physics in Medicine and Biology top 10 downloaded papers of 2017

Quantitative image reconstruction for total-body PET imaging using the 2-meter long EXPLORER scanner. Xuezhu Zhang, Jian Zhou, Simon R Cherry, Ramsey D Badawi and Jinyi Qi.

14,838 downloads

Metal artifacts in computed tomography for radiation therapy planning: dosimetric effects and impact of metal artifact reduction. Drosoula Giantsoudi, Bruno De Man, Joost Verburg, Alexei Trofimov, Yannan Jin, Ge Wang, Lars Gjesteby and Harald Paganetti.

4311 downloads

First patients treated with a 1.5 T MRI-Linac: clinical proof of concept of a high-precision, high-field MRI guided radiotherapy treatment. B W Raaymakers, I M Jürgenliemk-Schulz, G H Bol, M Glitzner, A N T J Kotte, B van Asselen, J C J de Boer, J J Bluemink, S L Hackett, M A Moerland, S J Woodings, J W H Wolthaus, H M van Zijp, M E P Philippens, R Tijssen, J G M Kok, E N de Groot-van Breugel, I Kiekebosch, L T C Meijers, C N Nomden, G G Sikkes, P A H Doornaert, W S C Eppinga, N Kasperts, L G W Kerkmeijer, J H A Tersteeg, K J Brown, B Pais, P Woodhead and J J W Lagendijk.

2933 downloads

A geometric atlas to predict lung tumor shrinkage for radiotherapy treatment planning. Pengpeng Zhang, Andreas Rimner, Ellen Yorke, Yu-Chi Hu, Licheng Kuo, Aditya Apte, Natalie Lockney, Andrew Jackson, Gig Mageras and Joseph O Deasy.

2184 downloads

obust sound speed estimation for ultrasound-based hepatic steatosis assessment. Marion Imbault, Alex Faccinetto, Bruno-Félix Osmanski, Antoine Tissier, Thomas Deffieux, Jean-Luc Gennisson, Valérie Vilgrain and Mickaël Tanter.

2017 downloads

Proton therapy of prostate cancer by anterior-oblique beams: implications of setup and anatomy variations. M Moteabbed, A Trofimov, G C Sharp, Y Wang, A L Zietman, J A Efstathiou and H-M Lu.

1994 downloads

Direct determination of k_Q for Farmer-type ionization chambers in a clinical scanned carbon ion beam using water calorimetry. J-M Osinga-Blättermann, S Brons, S Greilich, O Jäkel and A Krauss.

1602 downloads

Generation of synthetic CT data using patient specific daily MR image data and image registration. Kim Melanie Kraus, Oliver Jäkel, Nina I Niebuhr and Asja Pfaffenberger.

1488 downloads

A radiobiological model of metastatic burden reduction for molecular radiotherapy: application to patients with bone metastases. Ana M Denis-Bacelar, Sarah J Chittenden, Iain Murray, Antigoni Divoli, V Ralph McCready, David P Dearnaley, Joe M O'Sullivan, Bernadette Johnson and Glenn D Flux.

1484 downloads

Deep convolutional neural network with transfer learning for rectum toxicity prediction in cervical cancer radiotherapy: a feasibility study. Xin Zhen, Jiawei Chen, Zichun Zhong, Brian Hrycushko, Linghong Zhou, Steve Jiang, Kevin Albuquerque and Xuejun Gu.

1464 downloads

The **Rotblat Medal** for the most cited paper was presented to Kris Thielemans, Charalampos Tsoumpas, Sanida Mustafovic, Tobias Beisel, Pablo Aguiar, Nikolaos Dikaios and Matthew W Jacobson for their paper 'STIR: software for tomographic image reconstruction release 2' (Kris Thielemans et al 2012 Phys. Med. Biol. 57 867)