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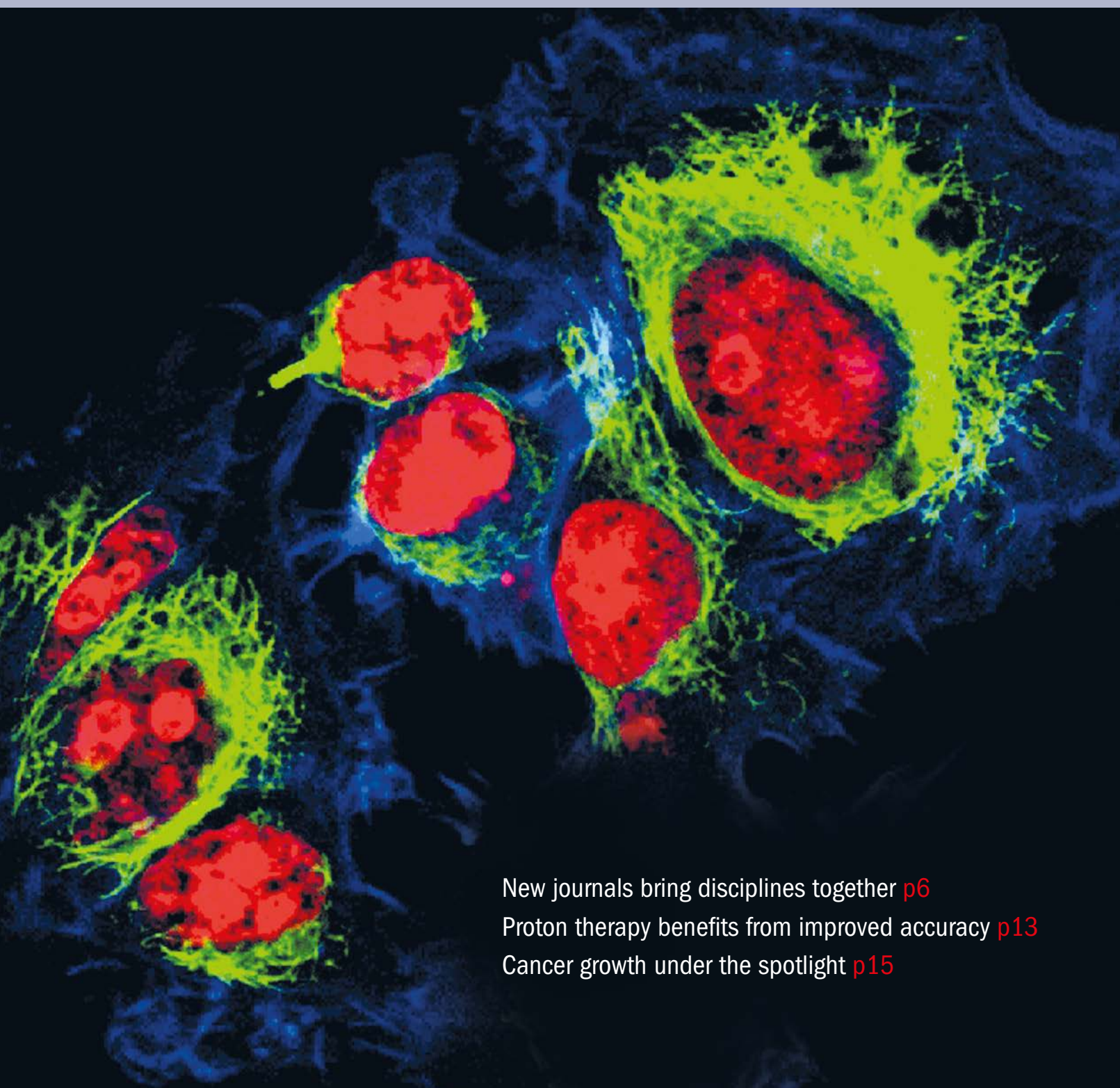
Taking research from the lab to the clinic



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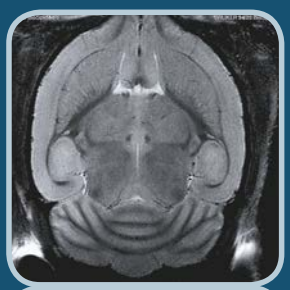
Multimodality Molecular Imaging



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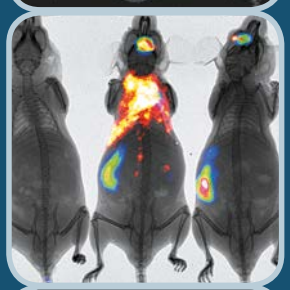

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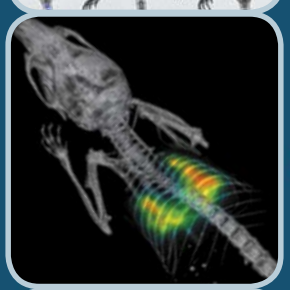

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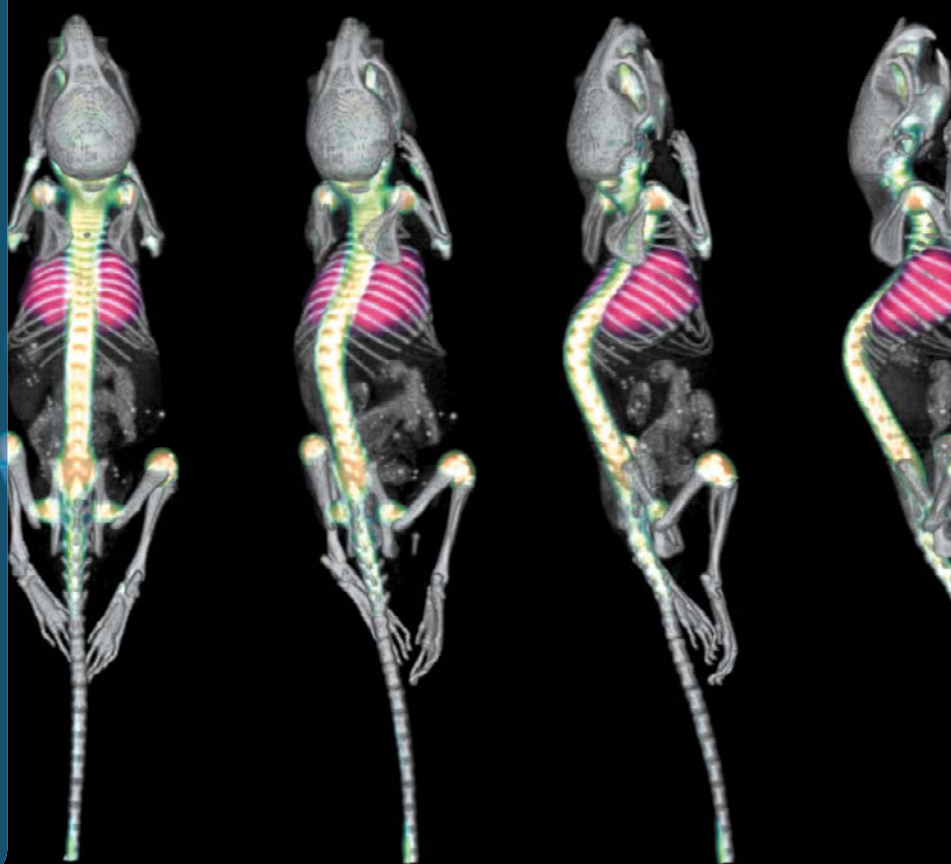

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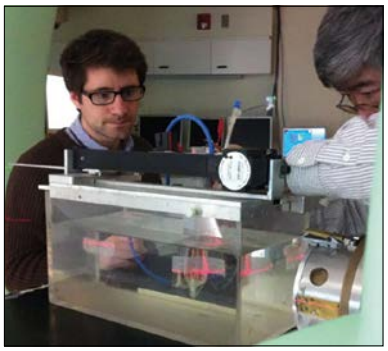
Innovation with Integrity

Ed Egelman sets the agenda p9



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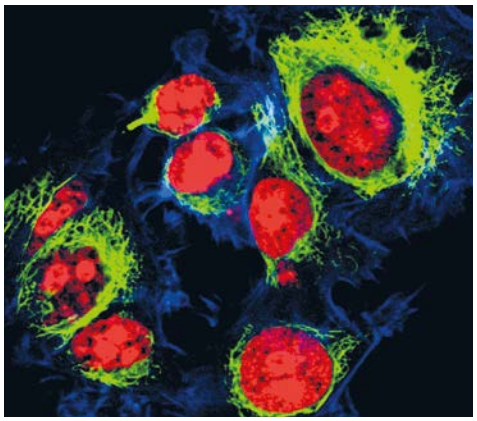
Taking research from the lab to the clinic

Welcome



Cover image: Physicists are increasingly working alongside biologists and biochemists to understand and fight disease. In this image, fluorescent imaging techniques developed by physicists have been used to study cancer cells in epithelial tissue, which covers and lines all of our internal organs. These cells form carcinomas, the most common form of human cancer, and in this image the nucleus is labelled with a red fluorescent dye, the cytoskeleton filaments appear green and the cell membrane is shown in blue.

"If the 20th century was the century of physics, the 21st will be the century of biology," asserted Craig Venter, one of the pioneering scientists who first sequenced the human genome, in 2004. The phrase has since become part of the scientific lexicon, but does not accurately reflect the true revolution that is taking place within the research community. While more science funding is certainly directed towards improving healthcare, the real change is that scientists who were once bounded by their individual disciplines are now working together to understand and fight disease.

One vital element of this newly convergent approach is that quantitative techniques rooted in physics are now being applied to understanding complex biological processes. Most obvious are the diverse array of imaging techniques routinely used to study everything from individual cells to parts of the human body. But some of the research highlighted in this special collection from IOP Publishing reveals how physicists are working alongside bioscientists and medical practitioners on problems as diverse as designing new biomaterials, developing improved diagnostic techniques, and understanding the complexity of human physiology.

IOP Publishing has long been a champion of this multidisciplinary approach, and now publishes 11 journals spanning medical physics, biophysics and biomedical engineering (see pp22–23). Many of these journals are leaders in their field, including *Journal of Breath Research*, *Biofabrication* and *Biomedical Materials*, while several are published in partnership with high-profile scientific organizations. As a result, we are now the second-largest publisher of papers in medical physics.

Further strengthening the IOP biosciences portfolio are two new titles, both of which embrace the multidisciplinary ethos. *Convergent Science™ Physical Oncology* (CSPO) enables scientists and clinicians to discuss collaborative research to understand, diagnose and treat cancer, and for the first time provides a voice for patient groups aiming to improve outcomes and wellbeing. Meanwhile, *Biomedical Physics & Engineering Express* (BPEX) is a broad and inclusive journal that offers rapid review for all manuscripts in the biomedical sciences. You can find out more from our Founding Editors on pp6–8.

We hope that you enjoy this special collection, and we hope to have the opportunity to work with you soon.

Pernille Hammelsø
Publishing manager, IOP Publishing
pernille.hammelsoe@iop.org

Ask the Editors

Convergent Science Physical Oncology

Novel journal unites cancer researchers

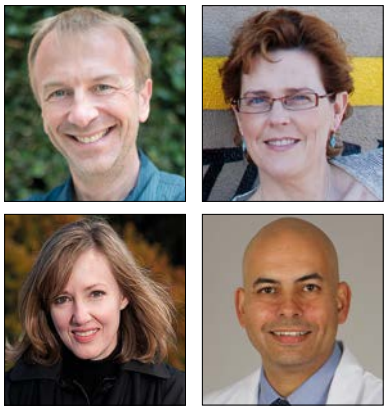
A new journal aims to stimulate a collective conversation among researchers from different disciplines but with a single mission: to understand how cancer forms and grows. **Tami Freeman** finds out more from two of the journal's Founding Editors.

Physical oncology – the use of physical sciences to better understand how cancer works – is a unique research field that brings together experts in chemistry, physics and biomedical engineering, along with mathematics and computer science. It also encompasses medical specialities including oncology, pathology, surgery and radiotherapy, as well as research at the human scale, such as investigating how to quantify the impact of disease and treatments on a patient's physical performance and wellbeing.

While studies in physical oncology have progressed rapidly over the last five or six years, there has been no obvious home for publishing such cross-disciplinary research. One particular challenge has been to offer researchers a peer-review mechanism that recognizes the combined contributions from many different fields, and IOP Publishing believes it has found a solution in its new journal, *Convergent Science™ Physical Oncology* (CSPO). The aim for CSPO is to bring together all researchers working within the physics of cancer and create a new forum for this exciting field of research.

"It's the physical properties of the body that enable the dissemination of cancer through the body," explains Peter Kuhn, Dean's Professor of Biological Sciences at USC Dornsife and one of CSPO's four Founding Editors. "Cancer cells interact with one another, they bump against walls, break through vessels and travel through the blood. There is both biology and physics at play at the same time."

"Several years ago, it became apparent that there was a need to look at cancer in a new and different way," adds Carole Baas, lead patient advocate for the National Cancer Institute's Physical Sciences-Oncology Centers (PS-OC), and another of CSPO's Founding Editors. "There was a lot of research being done that wasn't traditional cancer research, with people in different areas of science taking a look at cancer."



Pulling together
Founding Editors Peter Kuhn, Kelly Bethel, Carole Baas and Jorge Nieva offer different perspectives on physical oncology.

Baas explains that one example target area for such research is the tumour microenvironment. Studying the physical properties of tissue surrounding a tumour, for instance, could reveal whether certain aspects of the microenvironment make it conducive to cancer cells, providing information that could be exploited therapeutically.

"Right now, we don't know why cancers metastasize and why they decide to go where they do. If we are able to draw together many different areas of science and look at this from a really broad perspective – not just the biology – maybe that can give us insight into what's going on," Baas explains. "Physiology is one of the most complicated systems out there, so we need all voices to come together to solve this great question."

A multidisciplinary journal focusing on understanding cancer complexity as it evolves in the patient, and to the development of more effective diagnostics and treatment.

A new journal emerges

So how can all these disparate groups of researchers communicate their results in an effective way? Previously, physical oncology research was scattered among many different types of journals. Research papers would be reviewed and published in a journal in one specific field, but few outside of that particular area were likely to read it. "One of the missing pieces was how to actually communicate with one another," explains Kuhn. "And that is really how CSPO was born. The idea was that during the peer-review process, you have to have as equal partners the patient research advocate, the pathologist, the oncologist and the physicist."

As a consequence, IOP Publishing launched the journal with four Founding Editors representing these different stakeholder communities. Along with Kuhn (the physicist) and Baas (the patient advocate), Kelly Bethel from Scripps Clinic and Jorge Nieva from the University of Southern California provide the pathologist and oncologist points of view. "If the four of us can talk to one another and understand one another, then all of a sudden we have brought together very distant fields to look at this problem," says Kuhn. "Then we might actually be able to make progress."

Encompassing such a wide range of subjects can prove tricky when it comes to peer review of submitted papers. To tackle this challenge, the CSPO team is implementing a new type of review process, in which referees from different fields are actively encouraged to discuss a paper among themselves.

"Typically, a paper in, say, mathematics and cancer might get sent to

a mathematician and a cancer biologist. But the biologist can only judge the biology and the mathematician can only judge the maths," explains Kuhn. "If that work is truly built in a convergent framework, then the separate reviewers have to have a conversation – otherwise they can't evaluate the total value of that manuscript. I think it will streamline the refereeing process and make it way more fun."

The patient voice

Another key differentiator for CSPO is the inclusion of a novel section, provisionally called "Outcomes", which might include patient-authored perspectives, commentaries on topical issues, and cutting-edge science presented at a lay level. A clinical oncologist may, for example, write about how their research will impact patients; or a mathematician might explain how their modelling work will change the way that drugs are delivered.

"I am absolutely delighted that they have chosen to do this," says Baas. "It's pretty much unheard of to have a patient voice in a journal that is this technical." She explains that in her role as the lead advocate for the PS-OCs, she visited all 12 centres and talked to researchers, all of whom were really keen to hear patients' thoughts on their work. "In some cases, the researchers had never even talked to a patient with the type of cancer that they were studying," she notes. "The opportunity to connect with patients is not so easy if, for example, you're a mathematician working in this space."

In parallel, patient groups are excited about the new journal and this novel section, and are eager to learn more about research being performed. The idea is that CSPO will also provide a unique outlet for non-scientists to share their ideas. "At one event, a research advocate presented a great analysis of quality-of-life parameters," says Kuhn. "What was really interesting was the way she put together and analysed the data in a way I've never seen. I thought this would be great for my students to read, but there was no place for her to publish this."

Ultimately, the aim is to create a section that will be relevant to the entire readership. Patients, caregivers and other interested parties who don't traditionally read technical journals should be able to pick up this journal and find something that sparks their interest and that they can understand. "Hopefully this breaking down of barriers will increase interest, and subsequently funding, in this area," says Baas.

Looking forward, Kuhn predicts that CSPO could "play a true leadership role" in publishing manuscripts from the many high-ranking groups worldwide working in physical oncology. "I think it will enable not just communication, but the application of outcomes and will really propel the field forward," he said. "Everyone finds convergence a really attractive process, but doing it is brutally hard because we all have different perspectives. The question we are raising with CSPO is 'can we understand the physical aspects of cancer in the human and can we bring that data together so we better understand the human body?' The only way to do this is for all of us to participate equally."

"As a patient advocate, I see all different types of cancer research going on, but this is the one that truly excites me," adds Baas. "I want to go out and tell the world what's happening in this space and this journal is my way of doing it."

- CSPO is now open for submissions. Find out more at **iopscience.org/cspo**.

Ask the Editors

Biomedical Physics & Engineering Express

Bridging the gaps between the biosciences

The new multidisciplinary journal *Biomedical Physics & Engineering Express* aims to provide researchers working in all parts of the world with a forum to explore the intersections between medical physics, biophysics and biomedical engineering.

Researchers in fields such as medical physics, biophysics and biomedical engineering are well served by traditional journals. But for those working on the edges between disciplines or in interdisciplinary groups, the route to publication may be less clear cut.

Enter *Biomedical Physics & Engineering Express* (BPEX), a new journal from IOP Publishing that aims not just to cover all three disciplines, but to focus on bridging the gaps between individual areas.

"Medical physics, biophysics and biomedical engineering have developed independently, but we are now realizing that they have a lot of things in common," explains Founding Editor Robert Jeraj of the University of Wisconsin-Madison in the US.

One area that spans all three disciplines, for instance, is imaging. In biophysics, this mostly concerns optical imaging and microscopy, while medical physics relies on imaging for clinical techniques, and biomedical engineering helps develop technologies for both parts of the spectrum.

Robert Jeraj
BPEX Founding Editor.

Opening the doors

The scope of the new journal is intended to be broad and inclusive, covering any application of physics and/or engineering in either medicine or biology. "We're aiming to provide a common ground for discussion between the disciplines," continues Jeraj.

To foster this inclusive approach, BPEX will have three Deputy Editors working alongside Jeraj to represent the fields of medical physics, biophysics and biomedical engineering, but who have been selected for their ability to see beyond these individual fields. "In order to be effective in bridging between disciplines, we also have to be very good within each discipline," explains Jeraj. "That's why we have the team rather than just a single editor."

Global ambitions

One important goal of the new journal is to establish a broad geographical coverage, so the BPEX team has assembled an Editorial Board that comprises members from all across the globe. "Researchers will feel more comfortable submitting to a journal where they can see connections with people they might know, or from their country," Jeraj explains. "The Editorial Board is also tasked with identifying promising groups and researchers within their regions, and encouraging them to come together and to feel at home with BPEX."

Jeraj notes that BPEX's interdisciplinary model will particularly suit authors in countries where the three disciplines that underpin BPEX are less differentiated than in the USA or Europe. He also highlights the significant contributions that can be made by researchers who may not have access to state-of-the-art technologies. "Very often, people who don't have financial resources compensate by being more innovative," he says. "The research may not be really cutting-edge, but the ideas may actually be more innovative than those that just come from using advanced technology.

"There are smart people everywhere around the world," he continues. "This is a great way to bring them together and combine the most brilliant ideas in these disciplines from everywhere. I've already seen extremely high enthusiasm from groups around the world. They feel that the journal answers their needs by focusing on scientific rigour and innovation, not just on research using expensive equipment."

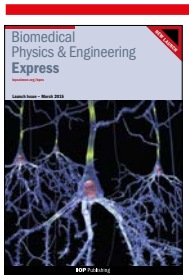
Express performance

Another key feature of BPEX lies in the "Express" in its title – which promises fast but rigorous peer review, with first decisions in less than 28 days on average. BPEX also offers the option for transfer from IOP Publishing's other titles, in particular when the paper doesn't quite fit into a journal's scope.

"If the paper is appropriate for BPEX, if it fits the scope and the criteria, and the authors agree to the transfer, then it goes on fast track," Jeraj explains. "The original reviews are taken into account, which speeds up the publication process and spares the referee pool. We are also considering the introduction of online commenting and feedback on the papers to continue the review process post-publishing."

Looking ahead, Jeraj hopes that in five years' time, BPEX will emerge as the key journal for interdisciplinary research of physics and/or engineering in medicine and/or biology. "The initial reactions that I've been getting have been extremely enthusiastic," he told *medicalphysicsweb*. "People think there is a real need for this interdisciplinary approach, especially for research that isn't quite within one discipline or spans subject fields. BPEX addresses a niche that is not adequately addressed in traditional journals."

- BPEX is now open for submissions. Find out more at **iopscience.org/bpex**.



An inclusive, international, multidisciplinary journal devoted to publishing new research on any application of physics and/or engineering in medicine and/or biology.

Q&A: Ed Egelman

Ed Egelman, president of the Biophysical Society, talks to Susan Curtis about his roots in physics, the ups and downs of research funding, and the role that professional societies should play in educating the public about the importance of science.

The annual meeting of the Biophysical Society, held in Baltimore, US, in February 2015, brought together experts in all areas of the biosciences. How would you define biophysics?

The annual meeting, like the Society, covers a broad spectrum of disciplines. It's not always clear what biophysicists do, particularly as the boundaries are changing all the time, but in my view the best definition is what they are actually working on.

A good example is molecular dynamics simulations, a physics-based tool that has been widely adopted and developed by chemists and biochemists – as recognized by the 2013 Nobel Prize in Chemistry. These simulations, which reveal in detail how atoms and molecules interact with each other, are yielding great outcomes in biophysics by speeding up new research and new discoveries. Increasing computational power will continue to accelerate our understanding of complex biological systems; our ability to sequence DNA, for instance, is following the same progression as Moore's Law for electronic devices.

You started your research career in particle physics, studying for a PhD with Nobel prize-winner Carlo Rubbia. Why did you decide to switch to biophysics?

I worked with a biophysicist during my undergraduate physics honours course, and got the impression that biophysics offered more freedom to explore the topics that might interest me. If I had continued in high-energy physics, I might have been the 151st author on a paper, but I wanted to have the opportunity to shape the research direction of a small team.

Ed Egelman President of the Biophysical Society.

How does your physics background help you in your current research field?

My area of expertise is electron cryo-microscopy, which relies on understanding the physics of scattering and image formation. My physics training has provided me with the skills and knowledge to run complex Monte Carlo simulations, to develop analytical formalisms, and to use them to understand experimental results.

Today, more people come to biophysics with a background in cell biology or biochemistry, and then it can be difficult for them to learn numerical techniques. In the US, students in the first year of graduate school receive more training and coursework, and that provides a good opportunity to get them up to speed with computational methods.

What are the challenges for physicists who wish to study biological systems?

One problem for physicists working in this field is that they always seek simplicity in complex biological systems, and sometimes it's just not there. There's a legendary text book, called *Molecular Biology of the Cell*, which was first published in 1983. At the time, everyone thought it would be complicated and difficult for students to understand. But almost everything in that book has been proven to be more complicated than originally described by the authors.

What are the prospects for students who aspire to pursue a research career in biophysics?

Unfortunately, we now have an acute funding issue that's affecting all biomedical research in the US. Funding through

Q&A: Ed Engelman

the National Institutes of Health doubled during the 1990s, so universities built new labs and scientists migrated towards the biomedical sciences. That was unsustainable, and since then the funding has declined.

This is now creating problems for students who want to follow a research career. Universities in the US have operated as training grounds for new research scientists, the idea being that graduate students and postdocs progress to become the faculty that train a new generation of scientists. But now there aren't enough faculty positions for the large numbers of postdocs who come through the system.

Organizations such as the Biophysical Society can play a key role in gaining public support for research funding. That comes down to science education in the classroom, not necessarily to train new scientists but to make people aware of what science does. In the US in particular, most people are ignorant of science, with most adults here refusing to accept that evolution happened.

The Biophysics Society now has 9000 members, with a third outside of the US, and the number continues to grow. What makes it so popular at a time when many other professional societies struggle to maintain membership growth?

The multidisciplinary approach makes it more interesting, plus it's run in a way that's both inclusive and democratic. The officers of the society are elected by members, while the Editor-in-Chief of the society's journal, the *Biophysical Journal,* is appointed for a fixed five-year term. It means that we don't have a clique at the head of the society.

At the meeting, too, students and junior researchers have the opportunity to present posters and talks in a series of focused platforms, while the more senior researchers who speak at the headline symposia are ineligible for speaking for the following two years.

How do you see the field developing in the next few years?

Computational techniques will continue to speed up the pace of progress, but experiments are still crucial, particularly in X-ray crystallography and high-resolution microscopy. In fact, the life sciences have really pushed the boundaries of what's possible with electron microscopy because biological samples scatter electrons only weakly.

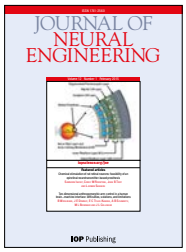
One key issue is that some datasets recorded by crystallography and microscopy are not accessible to the broader research community. In crystallography, scientists are required to make their structure factors available when they publish their work, but that now needs to be extended to other experimental techniques.

The NIH has launched a new initiative, called Big Data to Knowledge, which offers grants for projects that will make experimental data available to the wider research community. Alongside that, it's equally important that the data produced in experiments and simulations are entirely reproducible, which means that scientists should make their raw data available to allow wider scrutiny by the community.

Research news

Robotic arm gets the thumbs up

A paralysed woman taking part in a pioneering research study has for the first time been able to pick up and manipulate a range of objects with a robotic arm. Jan Scheuermann, who has been paralyzed from the neck down since 2003, has been involved with the research programme at the University of Pittsburgh for the past two years, and in the latest advance – reported in detail in the *Journal of Neural Engineering* – the team has been able to increase the manoeuvrability of the robotic arm from seven to ten dimensions.



The extra dimensions come from four hand movements – finger abduction, a scoop, thumb extension and a pinch – that enable Scheuermann to pick up, grasp and move a range of objects much more precisely than with seven-dimensional control. As a result, Scheuermann has progressed from giving researchers "high fives" to the "thumbs up".

The arm is controlled through a brain-machine interface that links a computer with two grids of electrodes that at the start of the study were surgically implanted into Scheuermann's brain, specifically the regions that are responsible for right arm and hand movements. Each grid of electrodes have 96 tiny contact points that pick up pulses of electricity fired between the neurons in Scheuermann's brain, and then computer algorithms are able to decode these firing signals and identify the patterns associated with a particular arm movement.

To begin with, Scheuermann could make the robotic arm reach out to objects by simply thinking about the arm movement. In the latest work, the researchers used a virtual reality computer program to calibrate her control over the robotic arm, which they found was vital to allow reliable, real-time interaction with objects.

"10D control allowed Jan to interact with objects in different ways, just as people use their hands to pick up objects depending on their shapes and what they intend to do with them," said co-author Jennifer Collinger. "We hope to repeat this level of control with additional participants and to make the system more robust, so that people who might benefit from it will one day be able to use brain-machine interfaces in daily life."

Commenting on the latest results, Jan Scheuermann said: "This has been a fantastic, thrilling, wild ride, and I am so glad I've done this. This study has enriched my life, given me new friends and co-workers, and helped me contribute to research and taken my breath away."

J. Neural Eng. **12** 016011

New Journal of Physics

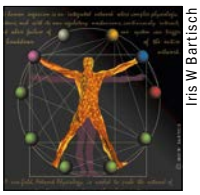
Complex networks probe secrets of the human body

Numerical techniques are increasingly being used to understand biological systems, sometimes giving rise to entirely new fields of study. One such example is network physiology and medicine, where concepts emerging from the theory of complex networks are providing fresh insights into the physiological structure of the human body and how it affects health and disease.

A recent focus issue in the *New Journal of Physics*, edited by Plamen Ch Ivanov of Boston University and Harvard Medical School in the US, explores how network physiology is being used to understand a number of different biological processes. These range from the genetic and sub-cellular level through to inter-cellular interactions and communications across integrated organ systems.

As examples, some of the articles in the issue describe how network theory can help to understand the spread of disease, improve the outcomes from deep-brain simulation, and identify links between brain activity and heart-rate variability in epileptic patients.

"The human organism is an integrated network where complex physiological systems, each with their own regulatory mechanisms, continuously interact, and where the failure of one system can trigger a breakdown of the entire network," explained Ivanov. "A new field, network physiology and medicine, is needed to probe the network of interactions among these diverse physiological systems."



Iris W Bartisch

Networks in the body
Ideas from complex network theory are being used to understand the interactions between different biological processes.

SOME ARTICLES IN THIS ISSUE

Identifying influential nodes in a wound healing-related network of biological processes using mean first-passage time
Tomasz Arodz and Danail Bonchev
New J. Phys. **17** 025002

Novel fingerprinting method characterises the necessary and sufficient structural connectivity from deep brain stimulation electrodes for a successful outcome
Henrique M Fernandes *et al*
New J. Phys. **17** 015001

Information dynamics of brain–heart physiological networks during sleep
L Faes *et al*
New J. Phys. **16** 105005

Research news

Journal of Radiological Protection

Power-line link to leukaemia puzzles researchers

A team of scientists in the UK has raised new doubts about a theory suggesting that an increased risk of leukaemia among children born close to overhead power lines could be linked to local air pollution.

The study, published in the *Journal of Radiological Protection* (the official journal of The Society for Radiological Protection), calls into question the so-called "corona-ion hypothesis", which has previously been cited as an explanation for the excess of childhood leukaemia cases reported close to high-voltage overhead power lines in the UK prior to the 1980s.

The hypothesis suggests that corona ions – charged particles that form in the air surrounding overhead power lines – can become attached to air pollutants, such as from traffic or smoking. According to the theory, these electrically charged particulates are more likely to be retained in the airways or lungs, which could lead to serious health problems, including childhood leukaemia.

Power play
Scientists still can't explain the increased levels of childhood leukaemia reported near power lines prior to the 1980s.

"We found in earlier studies that, for previous decades, childhood leukaemia rates were higher near power lines," said Kathryn Bunch of the University of Oxford, a co-author of the study. However, the same research showed no such link since the 1980s.

To test the corona-ion hypothesis, the researchers analysed data from more than 7000 children in England and Wales who were born and diagnosed with leukaemia between 1968 and 2008, and who lived within 600 m of a high-voltage overhead power line. The team calculated the exposure of each child to corona ions using a model based on parameters such as the voltage of the power line, the distance from the line, and how the concentration of corona ions varied with distance from the power lines. The model also took into account the wind conditions around the power lines.

However, the results showed no link between exposure to corona ions and the increased rates of childhood leukaemia identified before the 1980s. "This new paper seems to show that this wasn't caused by corona ions – but it leaves us still searching for the true cause," said Bunch. "We are undertaking further investigations of the variation in risk over time."

J. Radiol. Prot. **34** 873

Physical Biology

Physicists sound warning to 'nail beauty fanatics'

The daily trimming of fingernails and toenails to make them more aesthetically pleasing could lead to a range of serious nail conditions, according to researchers at the University of Nottingham.

Cyril Rauch and colleagues, who report their results in *Physical Biology*, have devised equations that help to explain what causes some of the most common nail problems, such as ingrown toenails, spoon-shaped nails and pincer nails.

"It is remarkable what some people are willing to do to make their nails look good, and it is in this context that I decided to look at what we really know about nails," said Rauch. "I quickly realized that very little physics or maths had been applied to nails and their conditions."

The equations formulated by the team describe the physical laws governing nail growth, and suggest that regular trimming – particularly when poorly done – can create residual stresses across the nail. Such residual stresses can over time cause changes in the shape or curvature of the nail, which in turn can lead to more serious nail problems.

The equations account for the strong adhesion of nails to the nail-bed, in particular the microscopic structures that allow nails to grow in a "ratchet-like" fashion by continuously binding and unbinding to the nail, as well as the mechanical stresses and energies associated with the nail. If the balance between these two stresses is broken – such as when nail grows too quickly or slowly, or the number of adhesive structures changes – residual stresses develop across the nail and cause it to change shape.

The results show that the residual stresses are more significant in larger nails with a flatter edge, which explains why ingrown toenails predominantly affect the big toe. "Looking at our results, we suggest that nail beauty fanatics who trim their nails on a daily basis opt for straight or parabolic edges, as otherwise they may amplify the imbalance of stresses that could lead to a number of serious conditions," said Rauch.

Nails under stress
The physical laws governing nail growth offer new insights into the causes of common nail conditions.

Moving forward, Rauch believes this research could be important for understanding hoof conditions in farm animals. "I believe that physics can make a difference by promoting a new type of evidence-based veterinary medicine," he said. "We can help the veterinary and farrier communities by devising trimming methods to alleviate pain and potentially remove the cause of serious conditions."

Phys. Biol. **11** 066004

Journal of Breath Research

Sweet-smelling breath offers diabetes test

A simple, non-invasive breath test has the potential to quickly diagnose children with type-1 diabetes before the onset of serious illness, according to research reported in the *Journal of Breath Research*. In one of the most comprehensive breath-based studies of children with type-1 diabetes to date, scientists based in Oxford, UK, have linked a sweet-smelling chemical marker in the breath with a build-up of chemicals that form in the blood when insulin levels are low.

The results could form the basis for a diagnostic device to identify new childhood cases of diabetes before the condition deteriorates to diabetic ketoacidosis (DKA), a serious condition where the bloodstream becomes acidic and the patient becomes dangerously dehydrated. DKA occurs when a severe lack of insulin prevents the body from using glucose for energy, which causes it to break down fat instead. This leads to the formation of organic compounds called ketones, which can accumulate in the body and cause it to become acidic.

About one in four children diagnosed with type-1 diabetes don't know they have it until they develop DKA. Acetone, the simplest ketone, is one of the by-products formed in the body as DKA develops, which is usually released through the breath. Indeed, acetone has been known for more than 200 years to produce a sweet smell on the breath of diabetes sufferers.

In the new study, researchers from the University of Oxford, Oxford Medical Diagnostics and Oxford Children's Hospital have helped to prove the link between increased levels of breath acetone and higher levels of ketones in the blood. "Our results have shown that it is realistically possible to use measurements of breath acetone to estimate blood ketones," said co-author Gus Hancock. The research team obtained breath samples from 113 children and adolescents between the ages of 7 and 18. Isoprene and acetone collected in breath bags were compared with capillary blood glucose and ketone levels taken at the same time.

Breathe out
Chemicals released through the breath could help to diagnose type-1 diabetes in children.

Analysis revealed a significant relationship between increased levels of acetone in the breath and increased levels of blood ketones, specifically hydroxybutyrate. But there was no such link between isoprene and acetone levels in the breath and glucose levels in the blood.

"We are now working on the development of a small hand-held device that would allow the possibility of breath measurements for ketone levels and help to identify children with new diabetes before DKA supervenes," said Hancock. "Testing for diabetes currently requires a blood test, which can be traumatic for children."

J. Breath Res. **8** 046010

Physics in Medicine and Biology

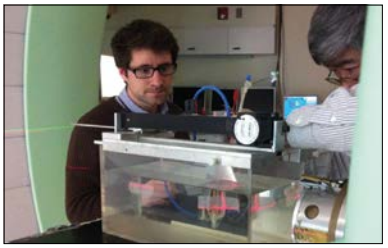
Proton radiographs improve range prediction

An international team of researchers has devised a patient-specific calibration scheme that could improve the accuracy of proton therapy for treating cancer. In the new approach, reported in *Physics in Medicine and Biology*, the scientists have exploited a novel proton radiograph to estimate the distance a proton travels through the patient based on water-equivalent path lengths (WEPL).

"The ability to be able to more accurately predict WEPL will ultimately allow for tighter treatment planning margins and a greater sparing of normal tissues, reducing the toxicity and risk of secondary cancers to the patient," said Paul Doolan, a team member from University College London (UCL) in the UK.

In conventional proton treatment planning, the particle range in the patient is estimated by converting the output from an X-ray CT scan into relative stopping powers (RSP). However, the conversion relies on standard values of tissue composition, which can lead to errors in the range prediction of up to 2%.

In their sights
UCL's Paul Doolan and co-author Hsiao-Ming Lu of MGH perform proton radiography measurements.



Proton CT scans could provide 3D images of RSP directly, from which WEPL maps can be derived, but the technique is not yet developed for routine use. As a more feasible alternative, Doolan and his collaborators from Massachusetts General Hospital in Boston, USA, and IBA in Belgium, developed a hybrid approach.

"Combining [2D proton imaging] with a high-resolution X-ray CT dataset allows us to combine the benefits of both techniques: the geometric, anatomical information from the X-ray CT and the RSP information that can be derived from a proton radiograph," he explained.

In this case, a WEPL map is derived from a proton radiograph taken in the planned direction of the therapy beam. The map is compared to a digitally reconstructed radiograph (DRR) created from the X-ray CT scan, which provides estimates of RSPs based on a generic conversion. By comparing the two datasets, the generic calibration curve can be adjusted to minimize the difference between them.

This optimization technique produced significantly more accurate WEPL values than those obtained with the generic calibration. The improvement was also seen in experimental measurements where the researchers acquired proton radiographs, along with X-ray CT scans, of two physical phantoms. "Following successful development of the detector and the technique, we anticipate the first patients could be imaged in two to three years," said Doolan.

Phys. Med. Biol. **60** 1901

Research news

Bioinspiration & Biomimetics

Morphing wings avoid drone collisions

Researchers in the US have taken inspiration from nature to create a robotic wing that can recover from mid-air collisions. By examining the movements of birds and bats, scientists at Stanford University have created a mechanism that could allow flying robots to squeeze between obstacles, such as the branches of a tree, and fully recover after hard impacts.

"This finding will greatly help make flapping winged drones much more robust," said co-author David Lentink. "This is essential if we ever want to safely fly through a forest or land in a tree like a bird."

In their study, part of a special issue in *Bioinspiration & Biomimetics*, the researchers demonstrate a man-made mechanism that copies the way that birds morph their wings, tucking them in close to their body to fly through narrow gaps. Unlike most previous mechanisms, the morphing of the wing is completely passive, making it much lighter and more reliable because no actuation is needed for folding and unfolding.

Inspired by nature
The wings on this drone flap in the same way as those of birds and bats.

The robotic wing, modelled on bird and bat wings, was made from standard carbon fibre and polyester film. Each wing was made from two rigid bodies – the arm wing and the hand wing – with a joint in between. The arm wing, which is attached to the shoulder joint of the robot, initiates the flapping, while the hand wing is attached to a hinged wrist joint that allows the hand to freely fold and unfold over the arm without any actuation. Each wing set had a wingspan of 400 mm and a length of 80 mm.

Theoretical, numerical and physical simulations showed that, as the wing flapped, the folded hand wing could open out to the full wingspan configuration. "Both the maths and simulations worked out, showing that both tiny and big flapping wings can all morph passively within a wing beat," said co-author David Lentink. "We were surprised it worked so well."

The hinged wrist joint also allowed the robotic wing to temporarily morph its hand when it came into hard contact with a steel rod. The robotic wing moved to comply with the object at impact, and after impact the flapping motion enabled the wing to automatically re-extend. This mimics the way that the flexible feathers of a bird allow for impact with obstacles without affecting the structural integrity of the wing.

"While birds are capable of responding to unexpected disturbances to their wings, these same disturbances would break the wings of most drones," said lead author Amanda Stowers. "The flapping wing can resist impact with minimal added weight and without any computer intelligence or power."

Bioinspir. Biomim. **10** 025001

Biomedical Materials

Biomaterial promises more successful implants

A novel coating that repels bacteria and attracts healthy cells could increase the success rate for medical implants, researchers from Singapore and Hong Kong report in *Biomedical Materials*. The biomaterial coating helps healthy cells to beat off competition from bacterial cells at the surface of the implant, which reduces the likelihood that the implant will be rejected by the body.

"The method we have developed helps the host cells to win the so-called 'race-for-surface' battle, forming a confluent layer on the implant surface that protects it from possible bacterial adhesion and colonization," said Vincent Chan of Nanyang Technological University in Singapore.

Chan and his colleagues at A*STAR (Agency for Science, Technology and Research) in Singapore and the City University of Hong Kong are hoping to reduce the failure rate of medical implants, which can reach 40% for some procedures such as hip replacements. Rejection is caused by biofilms that form on the surface when the implant is first inserted into the body, which can be initiated by bacteria sticking to the implant. This prevents healthy cells from adhering to the surface, and eventually causes the body to reject the implant.

In this study, the researchers attached specific binding molecules to multilayers composed of polyelectrolytes such as dextran sulphate and chitosan. After testing various concentrations of different ligands on cultures of healthy fibroblast cells and two different bacterial cells, the researchers found that the RGD peptide was particularly effective at inhibiting the attachment of bacterial cells and attracting healthy cells.

Improving implants
Researchers are hoping that biomaterial coatings could reduce the rejection rates for medical implants.

What's more, the biomaterial created by the researchers is completely safe for use in the body, unlike the antibacterial silver coatings currently used for medical implants. "The total amount of silver used must be very carefully controlled because high concentrations could kill mammalian cells and become toxic to the human body," said Chan. "The bioselective coatings we've created do not have this problem as the materials used are non-toxic and the preparation process uses water as a solvent."

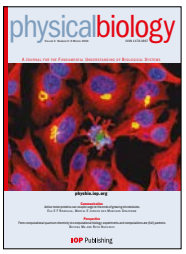
Chan cautions though that this "proof-of-concept" study has a long way to go before the coating can be used on real implants. "In future studies we hope to improve the long-term stability of the coating," he says.

Biomed. Mater. **10** 015015

Physical Biology

Tumour metastasis: environment matters

A team of US researchers has gained new insights into how cancer spreads through the body by looking at how cancer cells interact with their local environment. Reporting their results in *Physical Biology*, Michelle Dawson and colleagues at Georgia Institute of Technology, hope that their findings could lead to more personalized treatment for cancer patients.



The researchers studied two types of tumour cells that are known to metastasize from one part of the body to another: breast-cancer cells, which prefer rigid substrates such as bone, and ovarian-cancer cells, which prefer compliant substrates like fatty tissue. Dawson and colleagues assessed three important malignant characteristics – the cells' ability to grow, to survive chemotherapy and to migrate – when both types of cells were cultured on both soft and hard gel substrates.

"We recently discovered that ovarian-cancer cells, which preferentially metastasize to a soft environment, become more aggressive when grown on soft gels – the exact opposite of breast-cancer cells, which often metastasize to stiffer environments like bone," explained lead-author Michelle Dawson. "We performed this study to understand this disparate behaviour, and to elucidate the pathways responsible for the different mechanical preferences of ovarian and breast-cancer cells."

The researchers found that the ovarian-cancer cells formed and migrated more rapidly on the soft gel substrates, and were also more resistant to the anti-cancer drug doxorubicin. In contrast, significantly fewer breast-cancer cells formed on the soft substrate, while breast-cancer cells grown on the hard substrates migrated more rapidly and were more resistant to doxorubicin.

To understand these opposing responses, the researchers studied the cells' contractile behaviour, which plays an important role in cell migration. They found that breast-cancer cells are more contractile than ovarian-cancer cells, with the contraction mediated by a protein called myosin. By inhibiting non-muscle myosin in breast-cancer cells, the researchers were able to neutralize the influence of the surrounding matrix – which meant that the cells spread more aggressively on soft substrates and less aggressively on hard substrates.

The researchers also tested the effect of increasing the contractility of ovarian-cancer cells. This time the treated cells spread over larger areas and showed increased cell motility on hard substrates, while on soft substrates they collapsed in same way as the breast-cancer cells.

The team now hopes to apply its findings to biopsies taken from cancer patients. "However, this study required the generation of more than 1000 individual substrates by hand – something far from scalable to the clinic," said Dawson. "To address this, we are developing a high-content method to multiplex several of the experiments and automate the downstream analysis to enable large-scale translation."

Phys. Biol. **12** 026001

Physiological Measurement

Signal processing reveals cardiovascular secrets

Modern signal processing provides effective tools for describing dynamical interactions among diverse subsystems, and is particularly powerful when studying highly integrated networks composed of specialized, dynamical components. A recent focus issue of *Physiological Measurement,* edited by Italian researchers Alberto Porta of the University of Milan and Luca Faes and Giandomenico Nollo of the University of Trento, highlights how these techniques can be applied to the human body, treating it as a network of physiological systems connected together via a series of dynamical processes.

A particular focus for the issue is to better understand the interactions between different parts of the cardiovascular system, as well as links between the heart and the brain. It comprises selected contributions to the 8th Conference of the European Study Group on Cardiovascular Oscillations (ESGCO), held in Italy in May 2014. As with previous ESGCO meetings, the aim was to bring together researchers and medical practitioners to explore how concepts from signal processing can help not only to describe human physiology but also to improve diagnosis and prognosis in a clinical setting.

"The contributions in this issue suggest the power of advanced signal processing techniques in addressing clinical problems," write Porta, Nollo and Faes in their introduction.

SOME ARTICLES IN THIS ISSUE

Linear and non-linear brain-heart and brain-brain interactions, during sleep
L Faes *et al*
Physiol. Meas. **36** 683

Univariate and bivariate symbolic analyses of cardiovascular variability differentiate general anesthesia procedures
S Guzzetti *et al*
Physiol. Meas. **36** 715

QT variability improves risk stratification in patients with dilated cardiomyopathy
C Fischer *et al*
Physiol. Meas. **36** 699

Research news

Physical Biology

Scientists bridge the cultural gap

Ernest Rutherford, the celebrated physicist who first revealed the nuclear structure of the atom, famously declared: "All science is either physics or stamp collecting". Rutherford has often been accused of arrogance, but even today scientists who work at the interface between physics and biology can clearly identify cultural differences between the two disciplines.

"Physics is analytical, heavily dependent on mathematical equations; biology is more descriptive, heavily dependent on historical facts," write Howard Berg of Harvard University and Krastan Blagoev of the US National Science Foundation and Massachusetts General Hospital, who have curated a collection of insightful perspectives from physicists and biologists whose research depends on cross-disciplinary collaboration.

"We thought it would be of interest to hear from physicists who have negotiated this cultural gap," Berg and Blagoev continue. "What did they find challenging about biology, and how did they manage to begin work in such a different field? What advice might they have for younger practitioners of the art?"

According to physicist Ned Wingreen and biologist Bonnie Bassler, who have joined forces to study cell-to-cell communication, the key to a successful collaboration is good communication. A crucial starting point is to understand enough about each other's field to converse accurately and efficiently, and then create an environment where anyone in an interdisciplinary team can ask questions, challenge assumptions, or offer solutions.

"One of the great things about our long-term collaboration is that we have developed significant trust, both in terms of sharing information and in terms of respecting each other's judgment and insights," said Wingreen. "This is definitely a two-way street, both with physicists contributing to experiments (and in many cases learning to do the experiments) and biologists suggesting directions and ideas for modelling, and indeed learning to develop the models themselves."

Bassler, too, values the interplay between scientists who bring different expertise to the group. "Our collective imagination is our only limitation, not the gaps in each person's formal training," she said. "This arrangement makes it so that every day each of us is challenged, in a friendly way, to be smarter. We, and our shared science, thrive in this atmosphere."

SOME ARTICLES IN THIS ISSUE

Two cultures? Experiences at the physics-biology interface
John J Hopfield
Phys. Biol. **11** 053002

Working together at the interface of physics and biology
Bonnie L Bassler and Ned S Wingreen
Phys. Biol. **11** 053010

A theoretical physicist's journey into biology: from quarks and strings to cells and whales
Geoffrey B West
Phys. Biol. **11** 053013

Biofabrication

Lasers offer new route to tissue scaffolds

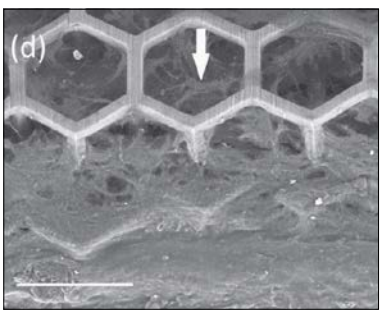
An interdisciplinary group of scientists in Lithuania has for the first time tested *in vivo* a complex tissue scaffold made by direct laser writing. Reporting their results in *Biofabrication*, the team has shown that the scaffold offers good performance and biocompatibility, paving the way for a full clinical trial of the tissue-engineering technique.

Direct laser writing (DLW) is an advanced fabrication method that creates material structures by scanning a tightly focused laser beam across a photosensitive material. It allows structures to be created directly from a computer model, much in the same way as a 3D printer – but one with unmatched spatial resolution and material choice.

DLW is already established as a staple tool in micro- and nanotechnology, and in principle could be highly effective for creating artificial scaffolds – 3D porous structures that help to nucleate and promote cell growth. To date, however, complex structures created by the technique have not been tested inside living organisms.

"The manufacturing technique is quite sophisticated," says Mangirdas Malinauskas, a laser physicist at Vilnius University. "Up to now only state-of-the-art setups worldwide can offer the required throughput in order to produce specimens for clinical experiments."

That's why Malinauskas teamed up with materials scientists, manufacturing technologists, biochemists and medics at various other Lithuanian institutions to test a scaffold fabricated using DLW. The scaffold was made from SZ2080, a hybrid organic–inorganic photopolymer consisting of organic acrylates and inorganic silicon and zirconium, and was structured as a 3D network of micro-hexagons designed to enable the growth of cartilage cells.



Promoting growth
Artificial scaffolds made with lasers can enable tissue growth inside the body.

The scientists implanted versions of the scaffold into rabbits, and removed them after 1–6 months to find out whether natural cartilage tissue had formed around the implant. They found that the scaffolds exhibited comparable biocompatibility to commercially available collagen membranes – a result that bodes well for studies with human cells and, eventually, clinical trials. "Currently, this research is being performed, [and we are] hoping to obtain positive results in the near future," says Malinauskas.
Biofabrication **7** 015015

Nanotechnology

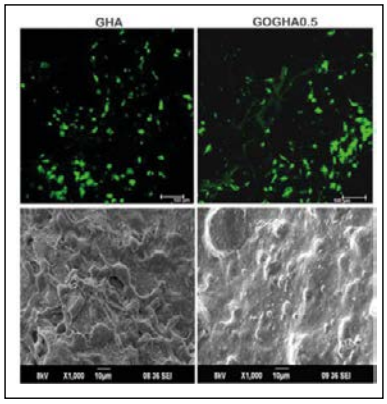
Nanocomposites encourage bone repair

Researchers in India have shown that adding nano-sized flakes of graphene oxide to the materials used for artificial bone implants can enhance their properties and speed up the healing process. The new findings, reported in *Nanotechnology* by Shantikumar V Nair and colleagues at the Amrita Institute of Medical Sciences and Research Centre, suggest that adding the nanoflakes to bone-like nanocomposites can encourage bone growth and repair.

"The greatest challenge is to design a biomaterial that matches the properties of native healthy bone," says team member Manitha Nair. "Properties like biocompatibility, chemical composition, porosity, degradation and mechanical stability are very critical to decide the success of the biomaterial."

Artificial bone implants are being developed to avoid the pain and limitations of using the patient's own bone in fracture treatments. Researchers have developed artificial materials that mimic natural bone, which is formed from hydroxyapatite – a porous phosphorous and calcium structure – and collagen. While collagen is too expensive to be used in artificial substitutes, gelatin has been investigated as a possible alternative.

On the mend
Nanoflakes of graphene oxide could improve the clinical outcomes from bone implants.



Nair and colleagues wanted to test whether graphene-oxide nanoflakes might enhance the performance of bone implants made from a hydroxyapatite/gelatin nanocomposite. While pristine graphene is prone to agglomerating, graphene oxide has chemical characteristics that can benefit cell health while also retaining the mechanical strength offered by graphene.

Their studies show that the addition of graphene-oxide nanoflakes accelerates the formation of stem cells, which are vital for the body to create bone-tissue cells, called osteoblasts, that are needed to repair bone fractures. "Usually, we need to include supplements," said Nair. "But even with just the basic culture medium, graphene oxide induces differentiation of stem cells into osteoblasts."

Further work is now needed to check the toxicity of the structures in live animals, and to test the speed and quality of bone regeneration. "Around 60% of graphene oxide was slowly released from the composite scaffold over a period of eight weeks, and that concentration was within the toxicity limit," says Nair. She added that bone is more tolerant to graphene oxide than other soft tissue, which is encouraging for the potential adoption of this approach for bone implants.

Nanotechnology **26** 161001

News from IOP Publishing

New director expands publishing horizons

Jamie Hutchins has been appointed Publishing Director of IOP Publishing. Jamie joined the company in 2012 as Head of Journals, and now assumes responsibility for IOP's growing portfolio of scientific journals, ebooks, and specialist magazines and websites.

"Exciting things are happening at IOP Publishing, and I'm looking forward to seeing what our talented publishing teams can achieve by working closely with the wider scientific community to further develop our publishing programme," said Jamie. "It is a period of dramatic change for the STM publishing industry, and researchers are working in new ways that create challenges and opportunities. We are dedicated to working alongside researchers, funding agencies and our partners to meet their changing needs and to redefine the role of a Society Publisher."

IOP publishes more than 70 journals, many in partnership with leading societies and scientific organizations worldwide. Since joining the company Jamie has developed the publishing programme to reflect areas where physicists collaborate closely with other disciplines, such as materials research and the biomedical sciences. This has resulted in five new journals – including two in the biosciences – with two more to come later in 2015. "The launch of the IOP biosciences brand focuses our commitment on the communities who work within these fields," Jamie commented.

Jamie has also worked closely with new and existing partners to enhance their publishing services, most recently announcing an ebook publishing partnership with the Institute of Physics and Engineering in Medicine (IPEM) to help the organization deliver its strategic objectives.

New faces
Jamie Hutchins (top) and Pernille Hammelsø.

"As a subsidiary of a major scientific society, IOP is in a unique position to understand the needs and requirements of our current and future partners," Jamie added.

• Pernille Hammelsø is the Publishing Manager responsible for IOP biosciences, a portfolio of journals covering all aspects of biophysics, medical physics, and biomedical materials and engineering.

Since joining IOP Publishing in 2014, Pernille has launched two new journals in the biosciences: *Convergent Science Physical Oncology* (CSPO), a cross-disciplinary journal for researchers aiming to understand the physics of cancer; and *Biomedical Physics & Engineering Express* (BPEX), which offers rapid review for all manuscripts in the biomedical sciences. More information on the two new journals can be found on pp6–8.

Open access made easier for Chinese researchers

The National Science Library of the Chinese Academy of Sciences (NSCL) and IOP Publishing have reached an agreement to support open-access publications for researchers at the Chinese Academy of Sciences (CAS). As part of the agreement, both organizations have committed to work together to create sustainable open-access options for the future.

CAS introduced its Open Access Policy in May 2014 and, since then, the NSCL has been working to establish efficient and streamlined processes with publishers. IOP has agreed to help CAS authors self-archive their accepted manuscripts by directly depositing papers published in IOP's journals in the CAS repository. NSLC will also fund part of the article publication charges for CAS authors who publish with IOP on a gold open-access basis. IOP and CAS will also work together to explore longer-term sustainable solutions for open-access publishing.

NSLC director Zhang Xiaolin said: "The NSLC is committed to supporting both the green and gold options for open-access publishing as an integral part of its information resource development. The NSLC believes it is time to proactively experiment with the transformation of library subscription funds towards open-access publishing funds so that quality subscription journals can be converted to open-access ones in a sustainable way."

"The NSLC is glad to be working with IOP Publishing to support this process, as we have a history of successful collaboration in endeavours such as creating solutions for the local, long-term preservation of IOP's journals."

OPEN-ACCESS PILOT SCHEME

IOP Publishing has been working with the library community on two pilot schemes to develop sustainable funding mechanisms for open access. In Austria, IOP is working with the Austrian Science Fund (FWF) and the Austrian Academic Consortium (KEMÖ). For research funded by the FWF, the organization will pay for researchers to publish articles in IOP subscription journals on a gold open-access basis. IOP will also offset the open-access charges paid by the FWF against the cost of subscription fees paid by KEMÖ. The second pilot will help UK-based researchers to comply with the open-access policies of funders such as the UK Research Councils. Participating universities are given a rebate on their subscription and licence fees when they pay for open-access publication in IOP's subscription journals, enabling libraries to help fund article publication charges.

IOP staff raise £8000 for local food charity

IOP Publishing's long history of philanthropy continued in 2014, as IOP staff raised more than £8000 for Bristol-based charity FareShare South West. During the year employees also gave 550 hours of their time through our volunteering initiative, and fulfilled many different personal challenges to raise money for their own favourite causes.

IOP supports these diverse activities through its Corporate Social Responsibility policy, which was formalized in 2011 to encourage staff to get involved with local organizations and charities. This year IOP employees have chosen to support Bristol Mind, a charity working to raise awareness of mental issues and to promote good emotional and mental health, with a range of fundraising activities.

- Alongside the efforts of its staff, IOP Publishing makes a large number of journal titles available to developing nations at no or very low cost, and waivers are in place to enable researchers in developing countries to publish in our open-access journals. Every year the publishing business gift-aids its operating profit to the Institute of Physics, a thriving learned society that today has more than 50,000 international members, to directly support physics and the global scientific community.

MEET THE TEAM

Visit us at the IOP booth at the following 2015 events:

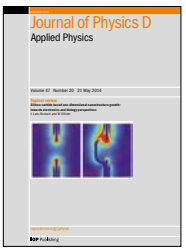
- **AAPM Annual Meeting**
  12–16 July 2015
  Anaheim, USA
- **European Biophysics Congress**
  18–22 July 2015
  Dresden, Germany
- **ASTRO Annual Meeting**
  18–21 October 2015
  San Antonio, USA
- **RSNA Annual Meeting**
  29 November – 4 December 2015
  Chicago, USA
- **ACSB Annual Meeting**
  12–16 December 2015
  San Diego, USA

JPhysD embraces the life sciences

Researchers who work at the interface between physics and the life sciences now have a dedicated publishing outlet within the pages of *Journal of Physics D: Applied Physics* (JPhysD). A new section, Biological Applications of Physics, is designed to highlight quantitative physical approaches to understanding biological and medical processes, and will be managed by a sub-board led by section editor Christoph Schmidt of Georg-August-Universität Göttingen, in Germany.

"I believe that there is a broad and important role of applied physics research in the life sciences.," said Schmidt. "We aim to provide an equally broad forum in JPhysD for the publication of research originating from the physical sciences with applications in the life sciences."

Giorgio Margaritondo of the École Polytechnique, Lausanne, in Switzerland and Editor-in-Chief of JPhysD added: "Applied physics, as physics in general, is not static but continuously evolving, and at present this evolution explores the border with the life sciences. In the new section for JPhysD, authors and readers will find a friendly and stimulating environment, and a manuscript review process by colleagues with a background and interests similar to their own."



RECENT BIOSCIENCES ARTICLES

Inward and outward membrane tubes pulled from giant vesicles
Raktim Dasgupta and Rumiana Dimova
J. Phys. D: Appl. Phys. **47** 282001

Magnetic force imaging of a chain of biogenic magnetite and Monte Carlo analysis of tip–particle interaction
André Körnig *et al*
J. Phys. D: Appl. Phys. **47** 235403

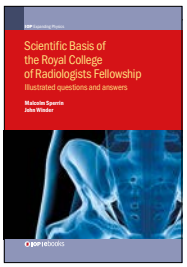
GaN-based micro-LED arrays on flexible substrates for optical cochlear implants
Christian Goßler *et al*
J. Phys. D: Appl. Phys. **47** 205401

Innovation drives IOP ebooks

IOP Publishing's award-winning ebooks programme now comes with the additional certainty that all publications will be preserved in the CLOCKSS Archive, a distributed network of redundant archive nodes located at 12 major research libraries around the world. "By archiving with CLOCKSS, IOP has ensured that the scholarship in their publications will be available for a worldwide audience now and in the future," said Randy Kiefer, executive director of CLOCKSS Executive Director.

IOP's ebooks programme currently comprises more than 30 titles published across two collections: IOP *Expanding Physics*, where leading researchers provide in-depth coverage of key topics, and IOP *Concise Physics* (published in partnership with Morgan & Claypool), which offers briefer introductions to emerging research fields. In 2014, the programme was awarded silver in the ALPSP Awards for Innovation in Publishing, with the judges recognizing the "boldness of IOP's reinvention of a core business, which sets digital and the user at the heart of its strategy".

The IOP ebooks programme offers multiple options for reading on different devices and incorporates elements such as mathML wherever possible. It has also been fully integrated with *IOPscience*, the company's online journals platform.



NEW AND UPCOMING TITLES IN BIOMEDICAL SCIENCES

EXPANDING PHYSICS

- *Scientific Basis of the Royal College of Radiologists Fellowship* **Malcolm Sperrin and John Winder**
- *Physics of Cancer* **Claudia Tanja Mierke**
- *Infrared Imaging: A casebook in clinical medicine* Francis Ring **Anna Jung and Janusz Zuber**

CONCISE PHYSICS

- *Nanoscopic Electrofocusing for Bio-Nanoelectronic Devices* **Shanmugamurthy Lakshmanan and Michael R Hamblin**
- *Skin Photoaging* **Rui Yin**
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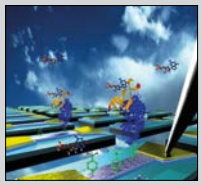
• Daily Mail • The Telegraph • ITV.com • The Engineer • Yahoo! News
Thomas Nowotny *et al* 2014 *Bioinspir. Biomim.* **9** 046007

Ten-dimensional anthropomorphic arm control in a human brain–machine interface: difficulties, solutions, and limitations
As reported in detail on p11, researchers at the University of Pittsburgh described in the *Journal of Neural Engineering* how they have helped a paralysed woman to control a robotic arm using a brain-machine interface. This story was covered by:
• Daily Mail • Daily Mirror • NBC News • Popular Science • Washington Post
B Wodlinger *et al* 2015 *J. Neural Eng.* **12** 016011



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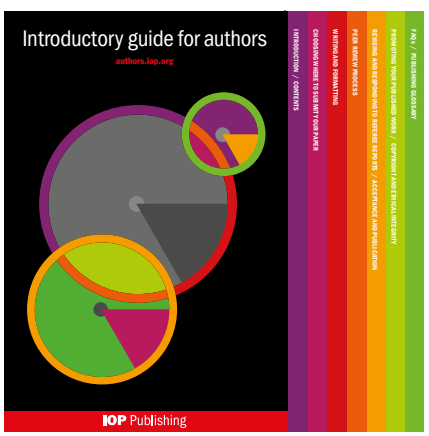

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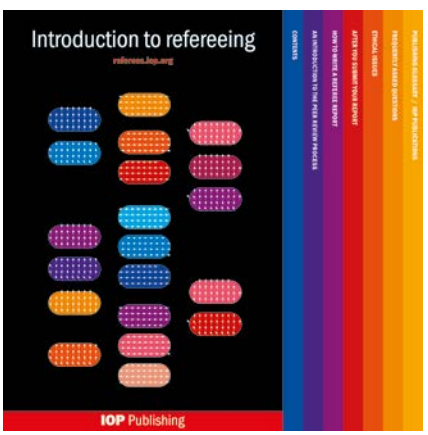

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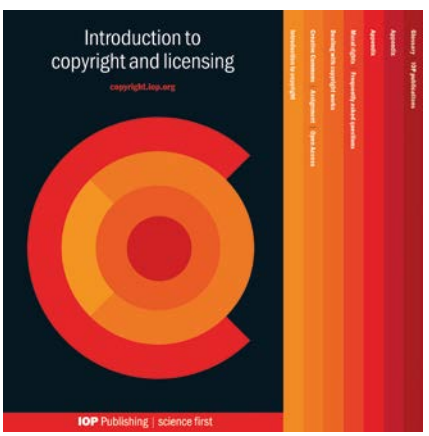

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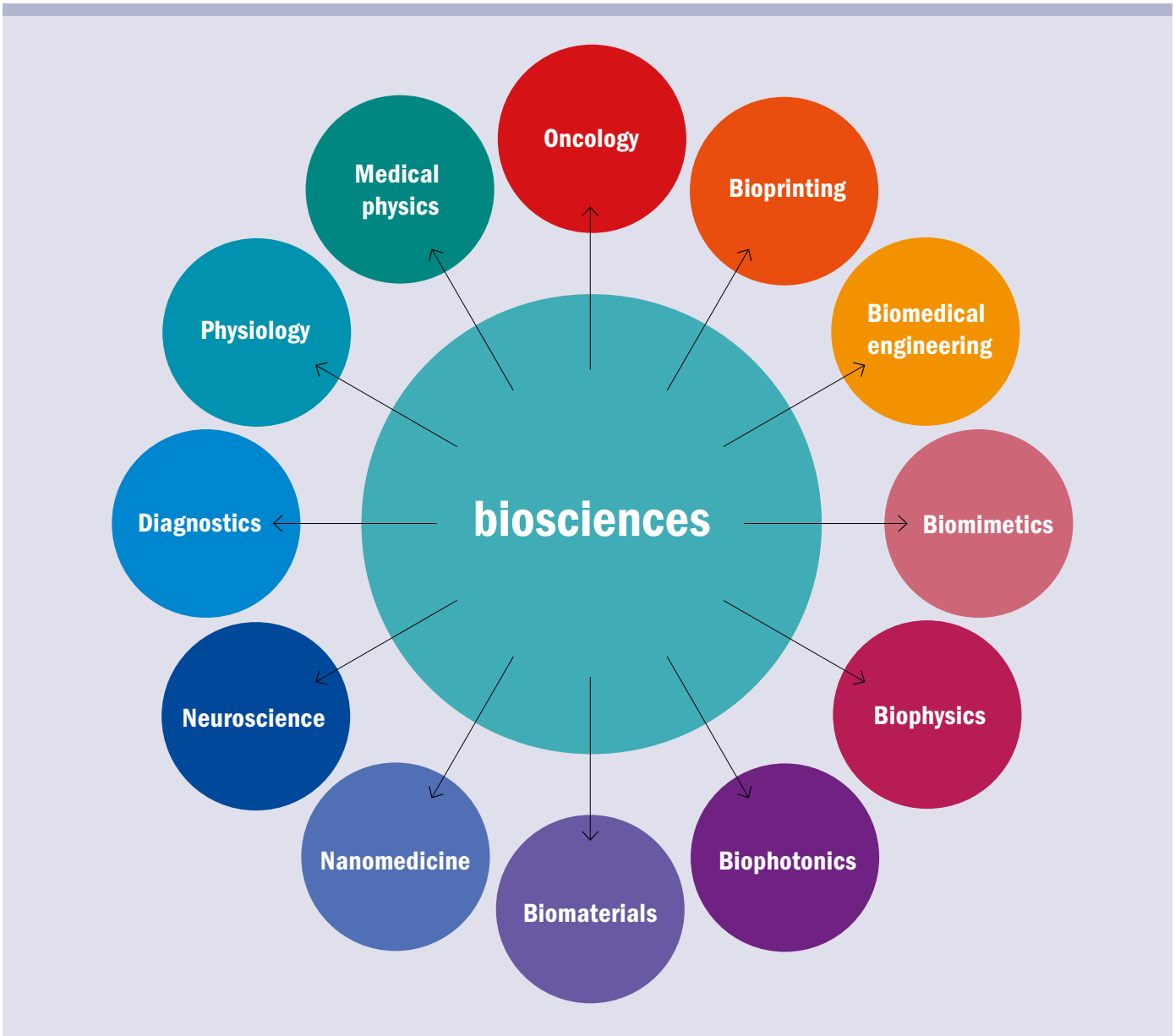

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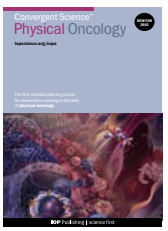

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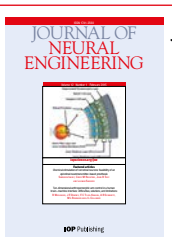

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