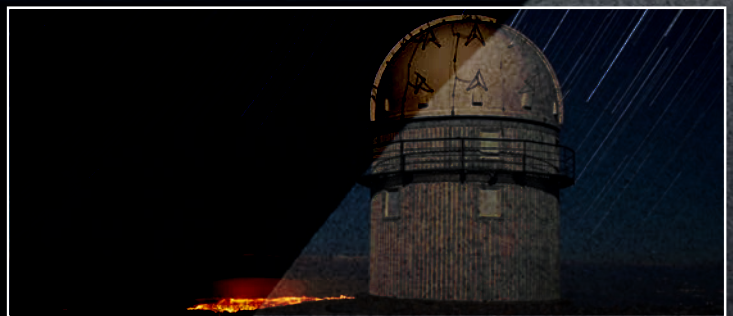


The Gianna Angelopoulos Programme for Science, Technology and Innovation



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Since its inception in 1209, the University of Cambridge has benefitted from the philanthropic investment of the many generous donors who have believed in our ability to make a positive contribution to the world. In return, our community has produced remarkable advances in almost every field of human endeavour.

The achievements of the University and Colleges are astounding, but perhaps our output in science exceeds all else. From the theory of gravity to the theory of evolution, from Rosalind Franklin to Stephen Hawking, our discoveries and our people have had an extraordinary impact on our view of the world.

Building on our solid foundations, the Gianna Angelopoulos Programme for Science, Technology and Innovation is a teaching and research programme of tremendous significance. Through education, through research and through vital collaboration with industry, the Programme will drive new discovery and further develop crucial international and cross-cultural links with Greece.

As our planet faces increasingly complex challenges and our need for brilliant researchers grows ever greater, I am absolutely delighted that Mrs Gianna Angelopoulos has made such a generous commitment to the development of young scientists at the forefront of their fields. Her vision is truly inspirational.

Stephen J Toope
Vice-Chancellor



It is a pleasure to introduce the Annual Report (2019–20) of the Gianna Angelopoulos Programme at the end of a year when we laid the foundations for this internationally unique ecosystem of training, research and entrepreneurial activity.

The announcement of the Programme was greeted with excitement by the academic and industrial community, who welcomed it as an outstanding opportunity for mutually beneficial engagement.

The Programme gained momentum very rapidly, in terms of recruitment and activities. Our call to the University to match the funding of the five-year Lectureships exceeded all expectations: three departments came forward and, rather than simply matching the investment, they endowed all three Lectureships to retirement age. Not only did this attract a better pool of candidates to recruit from and allowed us to make three appointments of the highest standard, but it serves as an example of the University's ability to multiply philanthropic investment, in this case adding £7.5 million into the Programme.

Beyond the promise of excellent academic research and industrial collaboration, the potential of the Programme to act as a catalyst for strengthening the links between the United Kingdom and Greece was recognised at government level: the launch of the Programme was addressed by the Ambassador of Greece in the United Kingdom and the British Ambassador in Athens.

Action on engaging with Greek academic institutions and industry under the *Impact for Greece* element of the Programme was immediate and on several fronts. GAPSTI offered scholarships to 15 PhD students studying at Greek universities to attend the High Performance Computing Academy, established a research collaboration between astrophysics departments at Cambridge and the University of Crete and offered grants to five Greek small-medium enterprises to take part in a three-month business growth programme at the University of Cambridge.

Looking at the year ahead, GAPSTI will build on the stable foundation provided by the University appointments in order to meet its remit of significantly accelerating the conversion of blue-skies research into disruptive technologies. It will also continue and expand the current actions under the *Impact for Greece* element, to ensure a fruitful two-way interaction between the University of Cambridge and Greek academia and industry.

Finally, on behalf of the University of Cambridge and all the beneficiaries of this Programme, I would like to thank Mrs Angelopoulos for reifying her commitment to education, entrepreneurship and economic growth into the significant financial support for GAPSTI.

Nikos Nikiforakis
Gianna Angelopoulos Professor of Computational Multiphysics

Overview of the Programme



Image, above: Supervision of students at the Maxwell Centre.

The Gianna Angelopoulos Programme for Science, Technology and Innovation (GAPSTI) is an ecosystem of training, research and entrepreneurial activity that supports high-impact disruptive technologies through a comprehensive programme of world-leading research.

The Programme nurtures talented early-career scientists, by means of PhD studentships, from postgraduate research to the successful commercialisation of their ideas, through a structured training and research programme enhanced by industrial collaboration and entrepreneurial activities.

The activities of the Programme are focused on the areas of Computational Multiphysics, Scientific Computing, Medical Therapeutics and Computational Materials Science, led by four corresponding University appointments (a Professor and three Associate Professors).

Based at the Maxwell Centre of the Cavendish Laboratory (Department of Physics) and extending, by means of its appointments, to the Departments of Materials Science and Engineering, the Programme is not intended simply to fund a range of research activities and studentships; it is also designed to feed directly into the research-business cluster, which has placed Cambridge high on the international innovation map in recent decades. The aim is to conduct research directed by business needs, which in turn encourages businesses to invest in more research, and to foster innovation at a global level by enabling international collaboration between academia, industry and public organisations.

To this end, the members of the Programme are guided by an International Scientific and Industrial Advisory Committee, comprising eminent academics and senior company executives.

An embedded 'Impact for Greece' element is establishing strong links with Greek academic institutions and industry, facilitating a two-way exchange of people and ideas. An annual symposium will ensure that the results of the Programme's research are widely communicated.

The Programme is overseen by the Board of Fund Managers, chaired by the Pro-Vice Chancellor for Research. Its membership comprises the Head of the Department of Physics, the Head of the School of Physical Sciences, the Donor and a member who is external to the University.

"GAPSTI is designed to feed directly into the research-business cluster, which has placed Cambridge high on the international innovation map in recent decades."

Gianna Angelopoulos-Daskalaki



This Programme would not have been possible without the vision and generosity of Gianna Angelopoulos-Daskalaki.

Mrs Angelopoulos is a lawyer, former parliamentarian, Ambassador at large of the Greek state and best-selling author.

In 1986, Ambassador Angelopoulos was elected to the Athens Municipal Council. In 1989, she was elected to the Greek Parliament and won re-election the following year. Following her marriage to Theodore Angelopoulos, Gianna resigned her seat in the Parliament to focus on family and business.

In 1996, Costas Simitis, the Prime Minister of Greece at the time, appointed her to lead the country's successful campaign to host the 2004 Olympic Games. In 2000, when slow progress and gridlocked bureaucracy put Athens in danger of losing the Games, she was asked to assume the Presidency of the Athens 2004 Organising Committee and save the project.

Her memoir, *My Greek Drama*, was published by Greenleaf Book Group in May 2013, and became a top ten *New York Times* and *Wall Street Journal* bestseller.

At Harvard, Mrs Angelopoulos has served as Vice-Chairman of the Dean's Council of Harvard's Kennedy School of Government (HKS) since 1994 and now also serves as a member of the Advisory Board of the Center for Business and Government.

In 2011, she established the Angelopoulos Global Public Leaders Program at the HKS to bring distinguished leaders to Harvard in order to interact with students, share lessons learned and reflect upon the next phase of their public service. Former President Felipe Calderón of Mexico, Former President Tarja Halonen of Finland, Former President and Nobel Laureate Juan Manuel Santos of Colombia and Secretary General Ban Ki-moon of the UN have participated in the programme to date.

Mrs Angelopoulos is the founder and sponsor of the Angelopoulos Clinton Global Initiative University (CGI U) Fellowship Program (100 young Greek entrepreneurs have benefitted), and a leading philanthropist for projects in Greece and around the globe.

In 2019, Greece's Prime Minister Kyriakos Mitsotakis appointed her as President of the 'Greece 2021' Committee for the celebrations of the 200 years since the Greek Revolution and the birth of the modern Greek state.

Launch at Cambridge

GAPSTI was launched in March 2019 at the Maxwell Centre of the Cavendish Laboratory, by the Vice-Chancellor of the University, Professor Stephen J. Toope, and Mrs Angelopoulos, in the presence of the Ambassador of Greece, Mr Karamitsos-Tziras. The event was attended by members of the University, international academics, company executives and Greek media representatives.

In his welcome the Vice-Chancellor referred to the role of the Programme in the broader context of the University's remit:

"The Gianna Angelopoulos Programme for Science, Technology and Innovation does two of my favourite things – it supports students, and it promotes collaboration.

"Sharing our findings and learning from each other is imperative, and at this time of great uncertainty, like us, Gianna has seen the great value of collaboration, both local and international, between industry and academia. Without the entrepreneurial skills and insight of industry, our scientific discoveries cannot achieve their full potential. In turn, industry needs the best scientists and research expertise in order to develop the technologies that will take us through the 21st century and beyond.

"At the heart of this Programme are the PhD students whose contribution to science, to Cambridge and to industry will undoubtedly be profound. Whether they follow academic careers or become captains of industry, with the strong, collaborative foundations provided by the Gianna Angelopoulos Programme, these talented young people will be the leaders of tomorrow. Our mission is to give them the education and resources they need; to help them develop the safe hands that will hold our future. They will be able

to do so for one reason only, and that is the inspirational philanthropic foresight of Gianna Angelopoulos.

"For more than 800 years, those who value independent thinking, education, research and innovation have supported Collegiate Cambridge. On behalf of the University, I thank you Gianna, for joining them."

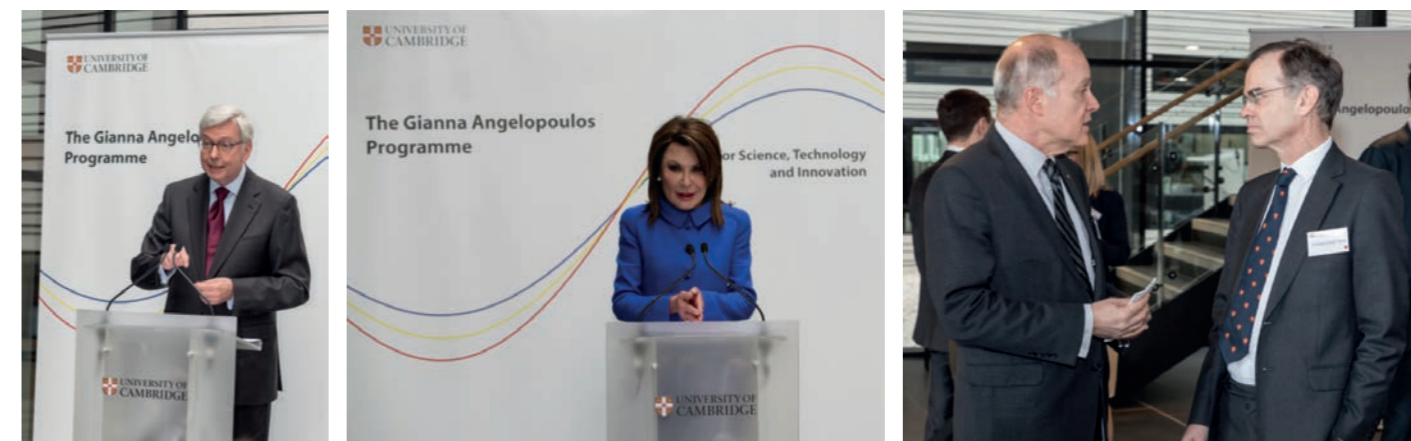
In her response, Mrs Angelopoulos noted:

"I may not be an expert in computational multiphysics formulas, but I know the human formula: talent plus hard work plus opportunity equals something amazing. And I believe that the participants in GAPSTI are capable of transformative breakthroughs."

She concluded by summarising the Programme:

"I can describe the Programme in two words: 'The Future'. It brings together talented academics and students from around the world. In return, for the opportunity to study and do research here, we will demand dedication and hard work. It is about accelerating the time from laboratory to the market, it is about minimising the time from idea to application for the good of the economy and society. And it is about connecting with Greek researchers, academic institutions and businesses, and building the links that will create opportunity.

I have always believed that the best investment is an investment in the leaders of tomorrow. And that is what GAPSTI is about: the next generation of leaders in science, technology and innovation."



Images, above:

Top row: the Vice-Chancellor and Mrs Angelopoulos. The Ambassador of Greece, Mr Karamitsos-Tziras, in discussion with Professor Andy Parker, Head of the Cavendish Laboratory. **Middle row:** the Director of the Maxwell Centre, Professor Sir Mark Welland, at the podium. Group photo, from left to right: the Ambassador of Greece, the Vice-Chancellor, Mrs Angelopoulos, Professor Welland, Mr Theodore Angelopoulos, Professor Nikiforakis and Professor Parker. **Bottom row:** Professor Nikiforakis at the Trinity College lunch. View of the Maxwell Centre atrium, where the event took place.

The GAPSTI presentation in Athens

The Programme was presented in October 2019 to members of the Greek academic community and industry at an event hosted at the residence of the British Ambassador in Athens. This was attended by HHM Ambassador to Greece, Ms Kate Smith CMG; the Pro-Vice-Chancellor for Institutional and International Relations, Professor Eilis Ferran; the Head of the Department of Physics, Professor Andy Parker; the Vice-Chancellor of the National Technical University of Athens, Professor Andreas Boudouvis; representatives of Greek universities and companies and government ministers.

In her address British Ambassador Kate Smith CMG referred to the strong links between academia and business:

“Groundbreaking research has defined the University of Cambridge for centuries. Partnerships are the key to fund future programmes, attract the finest postgraduates and enable excellence. Partnerships between the University, and its Colleges, with the cluster of entrepreneurs and companies around our city, with NGOs and institutes across the globe. Each relationship is reciprocal, enriching the entire network and multiplying our ability to ensure that the University’s next discoveries will deliver – on a global scale.

“The GAPSTI initiative represents the very best of collaboration between the UK and Greece – education, entrepreneurship and collaboration have never been more important, and it is wonderful to see such a prominent leader in the Greek community establishing such a future-facing programme.”

Mrs Gianna Angelopoulos spoke of her vision for Greece’s significant human capital, with reference to talented and promising young scientists:

“We want to support young scientists: bright, hard-working people who have excelled and whose professionalism is ready to take off. To support them, so that they undertake

research at the front line of scientific interest – but also where industry is in need of research input.

“I am very happy that 15 Greek students have already been able to follow a course in high-performance computing at Cambridge, while SMEs are also participating in a programme designed to help them develop their organisation’s managerial skills, setting them up to grow.

“Such is our philosophy, a philosophy that one finds at the core of the Cambridge Cluster, based on excellence; that is for research and business to work hand in hand from the very start – putting advanced instruments at the disposal of the real economy.”

Professor Eilis Ferran, Pro-Vice-Chancellor for Institutional and International Relations, University of Cambridge, noted:

“The ties that bind us to our European friends must be reinforced, and the Programme does exactly that, through exchanges of ideas, but equally importantly, through strengthening cultural understanding. GAPSTI enables all involved to make vital connections.”

The Programme Director, Professor Nikos Nikiforakis, presented the Programme, its progress to date and its future plans and concluded:

“The Gianna Angelopoulos Programme for Science, Technology and Innovation will lead in the development of science and industrial collaboration, and will contribute to the next 50 years of the Cambridge Phenomenon.”



Images, above:

Top row: Professor Ferran, the British Ambassador, Mrs Angelopoulos and Professor Parker in discussion. Mrs Angelopoulos at the podium. **Middle row:** Professor Nikiforakis and Professor Ferran at the podium. **Bottom row:** The British Ambassador at the podium. Group picture with Greek scholars and the Cambridge delegation.

University appointments

GAPSTI was initially set up as a five-year programme with funds for three fixed-term University Lectureships for the same period of time. However, the Departments of Engineering, Physics, and Materials Science and Metallurgy converted the temporary posts to tenured University Lectureships in Medical Therapeutics, Scientific Computing and Computational Materials Science.

University appointments: Medical Therapeutics



Above: Gemma working with the optical instrument, CYRIL. ©MetaboLight

A joint position between the Departments of Engineering and Physics was advertised as The Gianna Angelopoulos University Lectureship in Medical Therapeutics with a focus on the development of electronic/photonics devices for medical therapeutics with translation to industry and clinical practice. The Appointments Committee was looking for candidates with a track record of excellence in the development of devices and systems for health and wellbeing. In particular, it sought a demonstrated track record of innovative research and development of techniques applicable to industrially important areas such as medical electronics and medical photonics.

The successful candidate was Dr Gemma Bale, who has been developing new, non-invasive optical brain-monitoring techniques for the measurement of cerebral oxygenation and metabolism in areas where traditional brain monitoring isn't possible.

Gemma studied Physics at Imperial College London and gained a Master's in Photonics Systems Development from the University of Cambridge and University College London (UCL), where she was introduced to near-infrared spectroscopy (NIRS) – a non-invasive technique that can monitor the brain.

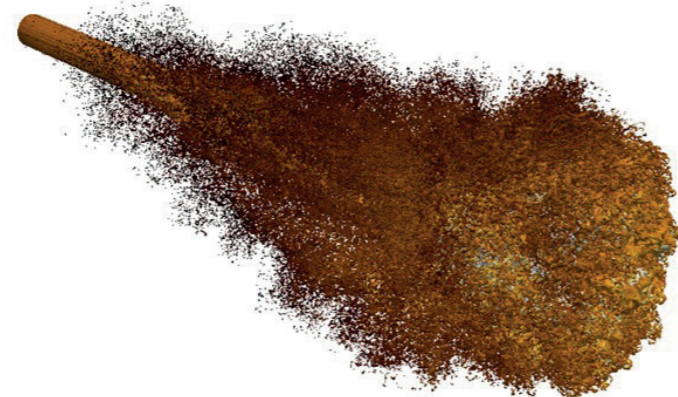
She develops broadband NIRS devices to monitor metabolism (via a mitochondrial enzyme, cytochrome-c-oxidase) in baby brain injury non-invasively. By analysing the data obtained by these instruments, Gemma demonstrated that NIRS measurements can diagnose brain injury during intensive care, days earlier than MRI. She further led the development of miniature broadband NIRS devices, which are being used internationally to monitor metabolism in a range of brain conditions. She has also made key advances in combining the

principles of NIRS and diffuse correlation spectroscopy (DCS) to measure cerebral blood flow and metabolism simultaneously and continuously in a single instrument for the first time. To undertake this development she brought new techniques to the UK following her work as a visiting scientist at the University of Western Ontario, Canada and the Institute of Photonic Sciences, Barcelona.

Throughout her career, Gemma has been passionate about communicating science outside of academia. During her PhD, she was awarded the UCL Provost's Engineering Engager of the Year award for her work in communicating science to the public in many forms – from stand-up comedy to teaching in schools. Post PhD, she led an award-winning public engagement platform called MetaboLight (www.metabolight.org). In 2018, she undertook a Media Fellowship – working as a science journalist for BBC Radio 2, and in the same year was awarded the Isambard Kingdom Brunel Award for Engineering, Technology and Industry by the British Science Association, as part of its prestigious Award Lecture series.

In her new position at Cambridge, Gemma has established the Neuro Optics Lab. This multidisciplinary research group will develop and validate new optical methods to monitor brain function and metabolism non-invasively. It will focus on optical methods to perform *in-vivo* monitoring of metabolic markers such as haemoglobin oxygenation, mitochondrial function and blood flow. The team will pioneer tools and techniques to monitor relevant physiology for both basic science and medical applications. As the work is highly translational, the group will work closely with clinical partners in Addenbrooke's Hospital and the Biomedical Campus to deliver technologies that progress medical therapeutics.

University appointments: Scientific Computing



Above: Liquid jet break-up from an OpenFOAM simulation.

The appointment at the Department of Physics was advertised as The Gianna Angelopoulos University Lectureship in Scientific Computing, with a focus on continuum modelling. The Appointments Committee looked for candidates who had a track record of excellence in the development of mathematical formulations and associated numerical algorithms for computational continuum physics, and in the implementation of these algorithms into software to simulate complex science and technology problems arising from industrial applications.

The successful applicant was Dr Hrvoje Jasak, a highly experienced practitioner and a co-author of OpenFOAM, the world-leading numerical simulation library for computational modelling in continuum mechanics.

Hrvoje is a professional programmer with 25 years of experience in C++ and object-oriented software design, High Performance Computing (HPC), numerical discretisation, linear algebra on HPC platforms and related topics. Hrvoje has been collaborating with over 150 companies and government research labs worldwide on problems in continuum mechanics, covering a range of models in fluid and solid mechanics, free surface, phase change, electro-chemistry and related phenomena. In his career he has managed large software projects and written over a million lines of C++ source code.

He studied Mechanical Engineering at the University of Zagreb, Croatia and gained his PhD in Computational Fluid Dynamics (CFD) at Imperial College London. After a stint with world-leading commercial CFD companies Siemens and ANSYS, where he worked on method and software development, Hrvoje founded a research group at the University of Zagreb, focused on practical applications of scientific computing, contributing to the numerical methodology and HPC support of modern simulation software both by theoretical developments and practical software implementation.

Hrvoje has supervised 11 PhDs and over 40 Master's students to date. Currently, he holds a Professorship at the University of Zagreb and a Mercator Fellowship at TU Darmstadt, Germany. During his career he has held a number of visiting and affiliated Professorships at leading institutions worldwide, including Chalmers University (Sweden), TU Delft (The Netherlands), University of Zaragoza (Spain), Seoul National University (South Korea), University of Brazil and University Santa Maria in Valparaiso (Chile). Hrvoje has initiated a series of OpenFOAM Workshop conferences (16th year) and runs an annual Summer School on Numerical Modelling of Coupled Problems in Applied Physics. He is a Chartered Engineer and a Fellow of IMechE and RINA.

An important aspect of Open Source software is its industrial deployment, as direct means of knowledge and technology transfer of new physics models and simulation tools from research into practical industrial use. As a new step in his career, Hrvoje is exploring the application of implicit solution methods and large-scale parallelised linear algebra on distributed computers and 100,000 core architectures, aiming for exa-scale performance in implicit linear solvers. On the modelling side, the focus of Hrvoje's work is strongly coupled solution of multi-physics equation sets, multi-state material models and multi-scale model hierarchies.

In 2019 Hrvoje received The National Award of the Republic of Croatia for outstanding scientific achievements by the Croatian Parliament. Hrvoje is a Fellow of Christ's College, Cambridge and is currently writing a book titled *The Practical Finite Volume Method* for release in 2021.

University appointments: Computational Materials Science



Above: A screenshot from Tomeu's YouTube channel.

The post at the Department of Materials Science and Metallurgy was advertised as The Gianna Angelopoulos University Lectureship in Computational Materials Science, and had a focus on atomistic and multi-scale modelling, applied to energy materials. The Appointments Committee looked for candidates with a track record of excellence in the development of innovative new methods for materials modelling that not only enhance existing capabilities, but also offer step-change improvements and radically different solutions. Part of the remit of this post was to expand the range of phenomena and processes that can currently be simulated and would be applicable to industrially important areas such as materials design, manufacturing, process modelling and building digital twins.

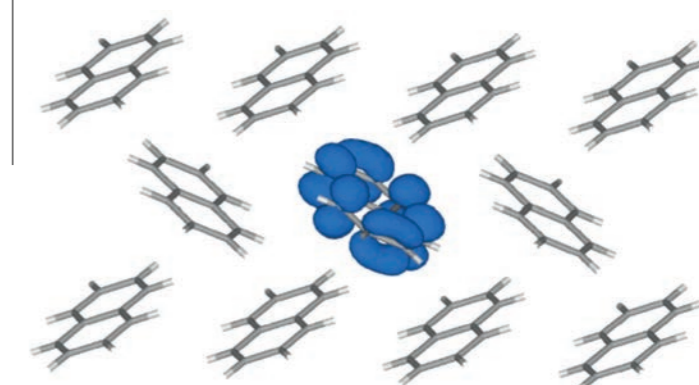
The successful candidate was Dr Bartomeu (Tomeu) Monserrat, who obtained a PhD in Physics from the University of Cambridge in 2015. Between 2015 and 2019 Tomeu concurrently held positions as a Postdoctoral Research Associate at Rutgers University in the USA, as a Henslow Research Fellow and a Winton Advanced Research Fellow at the University of Cambridge.

His work has been recognised with the 2018 Psi-K Volker Heine Young Investigator Award, an international prize presented to the leading young academic in the area of computational materials simulations. Tomeu has been recently named a 2020 IoP JPhys Materials Emerging Leader.

Tomeu's research group works on the development and use of quantum mechanical methods to investigate material properties. Their research focuses on one of the most pressing challenges of modern society: an environmentally sustainable future. Activities include the development of a class of exotic materials, called topological, that can carry currents without dissipating heat. This could help build low-power electronics to reduce the 50% energy waste of modern devices like computers and dramatically improve their energy use efficiency.

The group is also working on novel materials that can convert twice as much solar energy into electricity as current materials can, with the potential to double the efficiencies of solar cells. A computational solution to these problems provides microscopic insight to guide experiment at a small financial cost and with fast turnover, thus accelerating the technology revolution.

Beyond research, Dr Monserrat recently launched a YouTube channel named "Professor M does Science" www.youtube.com/c/professormdoesscience. The channel features short videos presenting quantum theory at the university level in a mathematically rigorous but approachable manner.



Above: An exotic excitation in a molecular crystal that could be harnessed to double the efficiency of solar cells.

Advisory Board appointments

The members of the Programme will be guided by an International Scientific and Industrial Advisory Board, who will advise on research directions, ensure academic integrity and provide a vital link with the industrial community. It is a pleasure to introduce the first two members of the Committee, Dr Simon Bittleston and Dr Leo Christodoulou. Simon and Leo had highly distinguished careers in industry and between them bring vast knowledge and experience to the Programme in the areas of energy, materials and manufacturing.



Dr Simon Bittleston recently retired as Vice President (VP) of Research from Schlumberger, the largest oilfield services company in the world, employing 100,000 people with revenues (2019) of £25 billion.

During his career Simon served as VP of Product Development & Manufacturing, VP of Mergers & Acquisitions, and more recently as VP of Science & Technology for a new branch of the company called New Energy, a division created to explore new carbon neutral solutions, prioritising energy storage and efficiency. His early career involved research into multiphase non-Newtonian fluid flows, heat transfer and solids transport. He created a range of new products and ran broad engineering teams, successfully commercialising large integrated systems, such as Q-Marine.

In mergers and acquisitions, he completed more than 40 transactions and also started the early stage venture investment team in Schlumberger. As VP of Product Development and Manufacturing he led worldwide technology centres with 5,000 scientists and engineers, and a \$2 billion dollar manufacturing organisation. He is an inventor on 30+ patent families (120+ granted patents worldwide) and the recipient of Gold and Silver Inventor awards.

Simon has engaged with several Departments of the University of Cambridge, including Physics, Chemistry, Mathematics and the Judge Business School, as a member of advisory, REF (National Research Excellence Framework) and strategic review panels. He has been involved with several research projects on energy, fluids and innovation at the departments of Engineering, Mathematics, Physics, Materials Science and the Judge Business School. He has served as a member of several UK Research Council panels and advisory boards on business and research.

Simon has kindly accepted the role of Chair of the International Scientific Advisory Board. Simon's knowledge of the University operations and Strategic Objectives, his engagement with the UK Research Councils, as well as his long-term career in technical innovation and technology transfer to industry, are perfectly aligned with GAPSTI's remit.

Simon holds a bachelor's degree in mathematics from Imperial College London, and a PhD in fluid mechanics from the University of Bristol. He is a Professorial By-Fellow of Churchill College and a Fellow of Darwin College.



Dr Leo Christodoulou is a former Engineering Executive at the Boeing Company who has held senior positions in the US government and industry, and has engaged with university research as Boeing's Global Executive Director for University and Laboratory Research and Technology.

During his career at Boeing, Leo has held a number of positions including Enterprise Domain Leader for Materials, Structures and Manufacturing, where he was responsible for the Boeing Enterprise Technology Strategy encompassing worldwide investments and global sites and legacy companies. Leo has undertaken tasks of strategic importance to Boeing such as leading Boeing's 787 Li-ion battery recovery and requalification, and also establishing Boeing's Additive Manufacturing (BAM) Division.

Prior to his appointment at Boeing, Leo held the posts of Senior Executive Service Director of the Advanced Manufacturing Office at the US Department of Energy (DoE), and Senior Executive Service Director of the Defense Sciences Office at DARPA (Defense Advanced Research Projects Agency). During his time at DoE, Leo created the Advanced Manufacturing Office and redirected the investment into sustainable technologies for energy generation, water purification, industrial plant energy efficient operations, training and technical assistance to small business enterprises. Leo is a founding member of former President Obama's Advance Manufacturing Initiative and has created the National Manufacturing Demonstration Facility at Oak Ridge National Laboratory with specific interest in energy efficient digital manufacturing with special emphasis on Additive Manufacturing.

Among his many awards and distinctions, Leo holds the Grunfeld Gold Medal and Prize, Jefferson Cup, Medal for Distinguished Public Service (highest honour awarded to a civilian in US Government), American Society for Metals (ASM)/ Minerals, Metals & Materials Society Distinguished Medal and Lectureship in Materials and Society 2008, and multiple Excellence Awards from the Boeing Company, US Department of Energy, US Department of Defense, Martin Marietta Corporation and Materials Societies. Leo is a Fellow of ASM International.

Leo holds BSc and PhD degrees in Metallurgy from Imperial College London. Before joining industry, he was a Reader (Associate Professor) in the Department of Materials and Engineering at Imperial, where he established a research group in materials. During his time at Imperial, Leo served as the Course Director of the MSc in Materials Research and he established a new four-year (M.Eng.) course in Aerospace Materials.

Impact for Greece

Impact for Greece: Scholarships for Greek scientists



Above: The participants of the Academy at the front of the Centre for Mathematical Sciences, where the lectures and computing practicals took place.

GAPSTI provided scholarships for Greek scientists to attend the Autumn High Performance Computing (HPC) Academy

The Centre for Scientific Computing at the University of Cambridge annually hosts the Autumn High Performance Computing Academy. The overall aim of this two-week course is to provide attendees with a strong background in elements of high performance computing techniques suitable for general science and technology projects.

The course is taught by experts from several universities and HPC organisations across the United Kingdom who introduce the students to a range of topics suited to high performance software development, including command-line Linux, version control, data structures, and super-computer cluster queuing systems. Topics include Introduction to Linux, Scientific Programming in C++, Performance Programming, Parallel Architectures, OpenMP, MPI (Message Passing Interface) and Software Development.

There were additional seminars from academics and industrialists on how HPC is helping their research and

development and their operations. These included Dr JB Bell and Dr AS Almgren (Lawrence Berkeley National Laboratory), Dr F Monmont (Schlumberger), Dr J Jones (Cray) and Dr J Martin (MathWorks – MATLAB).

The course is very much hands-on, with several practical sessions where the participants work in groups on their assignments and are tutored by the lecturers. The groups have to present their results to the rest of the participants. As a result, at the end of this very intensive course, attendees are able to write a range of numerical algorithms in C++, understand what issues affect the performance of the code, and become familiar with methods of utilising multiple CPU cores.

GAPSTI offered 16 scholarships to Greek graduate students, postdoctoral researchers and staff members of Greece-based SMEs (small/medium-size enterprises) so that they could travel to Cambridge and take part in this course. The scholarships covered their travel and subsistence expenses, as well as the course fees.

HPC Academy lectures and seminars took place at the Centre for Mathematical Sciences, a modern set of buildings that



Above: The students working on the computing practicals.

are home to the Faculty of Mathematics, the Department of Pure Mathematics and Mathematical Statistics (DPMMS), the Department of Applied Mathematics and Theoretical Physics (DAMTP), the Isaac Newton Institute and the Betty and Gordon Moore Library.

All of the GAPSTI-sponsored students were accommodated at Selwyn College, a historical building dating from 1882, which is situated a short walk from the city centre. They also had the chance to visit Newnham, a women's college established in 1871, a time when women were not allowed to attend the University. Newnham hosted a seminar and the end-of-course dinner, where students enjoyed a formal dinner with some of the course organisers, lecturers and seminar speakers.



Above: Dr Philip Blakely lecturing the students.



Above: The Old Court of Selwyn College, where the students lodged.

“I really enjoyed that I had the chance to learn so many great things from top-notch researchers in the field!”

“The lecturers were extremely knowledgeable and obviously cared about delivering a good course.”

Impact for Greece: SME strategic business growth



Above: Professor Kavadias in a session with the participants.

GAPSTI offered support to Greek SMEs to participate at the Judge Business School Strategic Business Growth Programme.

Since 2015, the Entrepreneurship Centre of the Cambridge Judge Business School (CJBS) has been offering a programme dedicated to SMEs, the Strategic Business Growth Programme. Led by Stelios Kavadias, Margaret Thatcher Professor of Enterprise Studies in Innovation and Growth, the programme's aim is to systematically develop the managerial capability of SME leadership teams.

The Programme is designed for SMEs with an annual turnover above £500k, governed by talented and ambitious management teams who are seeking to scale up their companies. Each company participates with up to three executives including the CEO or managing director.

Participant teams set attainable growth objectives and get help to achieve these using a set of tools, as well as some key performance indicators to monitor their progress. A series of six workshops is delivered in three two-day modules over the course of four months. The sessions provide access to the latest management thinking on developing and managing growth, and facilitate the development of customised actions based on the workshop insights as well as the experienced growth challenges of the participant companies.

For its fifth cohort (September 2019–January 2020) GAPSTI offered funding to five Greek SMEs to enable their participation in this Programme, namely Corporate Relocations Greece, Elemsi, Elviomex ALFA, Klimatechniki and Watera. The companies were all from different backgrounds (services, manufacturing, utilities) but all shared a desire to develop their leadership team and define a growth strategy.

The participants valued the fact that they were able to identify the challenges lying ahead, to draw a growth plan that helps overcome the challenges, and to master new tools that help them implement the growth plan.

Feedback from the participating SMEs

Corporate Relocations: With mixed feelings, we just finalised the third and final module at Cambridge University. On the one hand, we feel so fortunate we had the opportunity to participate in this enlightening journey. It was an absolute pleasure to meet and be educated from professors lecturing in the programme, sharing their knowledge, in making us understand how we can evaluate our company, be better leaders, rethink our marketing and most of all learn how to continue servicing our clients in the best way in this constantly changing world. Their hospitality, authenticity, and friendliness were unique.

On the other hand, and since we have gained so much self-confidence on the paths we need to follow, we already feel nostalgic for the care and protectiveness we have felt from these people the past few months and do not wish to lose it ... all our fellow students share the same sentiment that we would like this journey to have continued forever! However, we know that our true journey just started, and we now possess the tools and the knowledge to continue. Most importantly we rest assured that from now on we know where to turn to if valuable help is needed! (Maria Kouri, CEO)



Above: Stefania Voloudaki and Maria-Christina Kouri from Corporate Relocations.



Above: Eleni Theodorakopoulou from Elemsi.



Above: Professors Kavadias and Nikiforakis with the Programme participants at the Judge Business School.

Elviomex: Our participation in the SME growth challenge programme was a unique chance for us to learn who we are, who we want to become and how we will manage to make this happen. The Programme covered most of the aspects that a management team must take into consideration in order to drive the growth of the organisation, and moreover it taught us where we, as a management team, have to focus and how we can work together in order to motivate everyone inside our company to get engaged with our vision. The modules were perfectly designed and the interaction during them as well as the time between them was essential in order to turn theory into practice. We really managed to change our mindset, focusing on what really matters and setting up a growth strategy that can be followed and can achieve results. (Leonidas Avgerakis, CEO)

Elemsi: In these three modules we learned a lot of new things about enabling and implementing our strategic growth, how to create a culture for growth within our company and how to manage productivity, profitability, customer satisfaction, and employee motivation. Each module gave us different cognitive skills, ideas, and implementations that will become very useful tools for us. Even the workshops during the sessions gave us the first 'seed' from which we began to expand the way we think and therefore the way the business operates. Certainly,



Above: Apostolos Avgerakis and Leonidas Avgerakis from Elviomex.

the most productive part for our company was the coaching sessions between the modules that gave us the opportunity for constructive brainstorming and teamwork to develop new ideas for our future growth. Undoubtedly, we will use all of these useful tools for setting up a new strategic position that will help us be sustainable and efficient. We hope in the future to have the opportunity to participate in another strategic plan for the further development of our business by learning more from our teachers. (Dimitris Stamatelopoulos, CEO)

Impact for Greece: Connecting astronomers

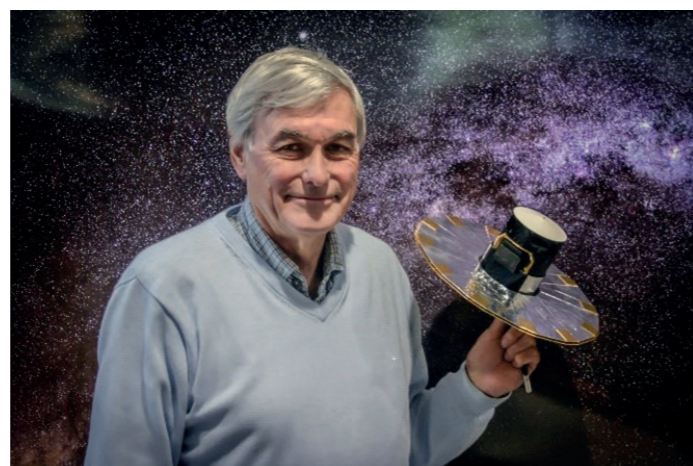
GAPSTI supports collaboration between the Institute of Astronomy at Cambridge and the Institute of Astrophysics – FORTH in Greece

One of the first actions of Impact for Greece was to facilitate the growth of an ongoing strategic collaboration between the Institute of Astronomy (IoA) at Cambridge and the recently founded Institute of Astrophysics at FORTH (the Foundation for Research and Technology – Hellas), on the island of Crete in Greece.



A joint project has been initiated between the two institutions, which will bring together two major projects, namely Gaia and PASIPHAE, to help astrophysicists understand stars like never before. Gaia is the flagship ESA (European Space Agency) mission, taking the most complete census ever of stars in the Galaxy, and its UK activities are led by Professor Gerry Gilmore's group in Cambridge. PASIPHAE is a game-changing survey of stellar optical polarisations, and is led by Professor Konstantinos Tassis's group in Crete.

The interaction will be facilitated by a PhD research post at each institution, one funded by GAPSTI and the other by the Institute of Astrophysics at FORTH. The students will work on common projects co-supervised by Professors Gilmore and Tassis. They will



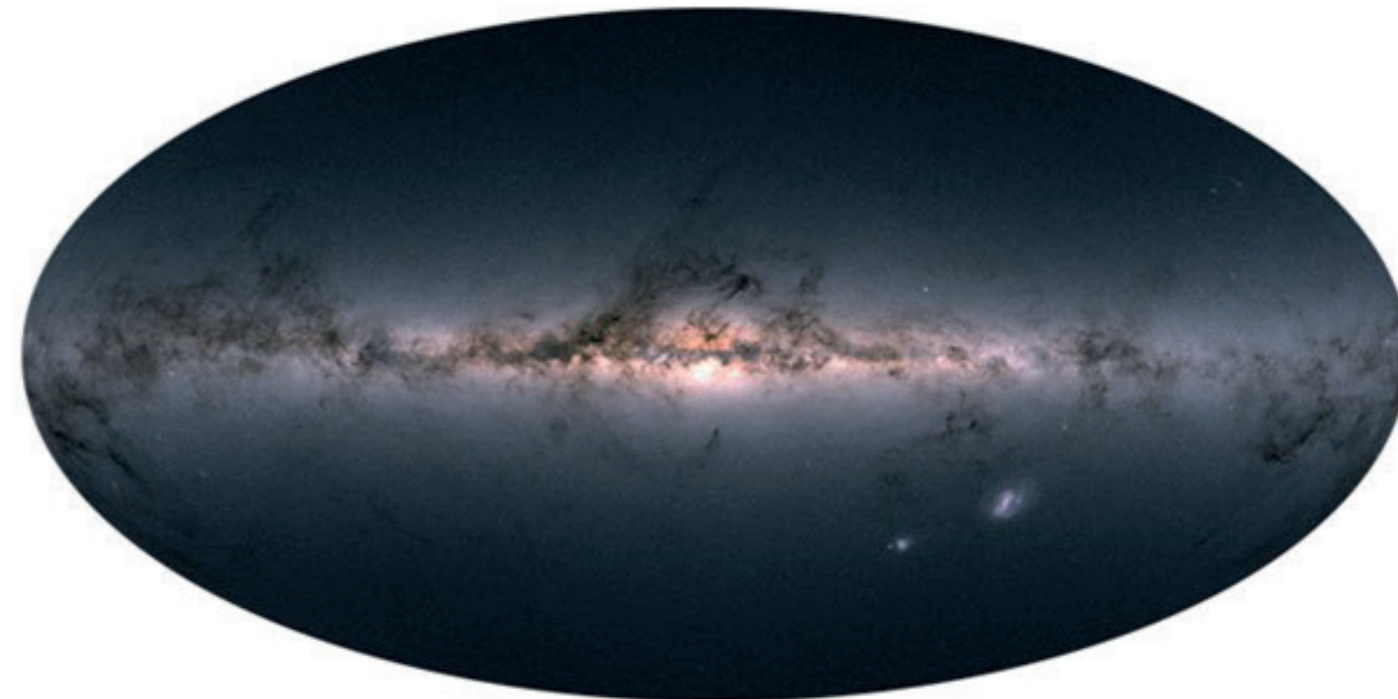
Above: Professor Gerry Gilmore, Professor of Experimental Philosophy, at the Institute of Astronomy, University of Cambridge.

jointly participate in secondments at high-profile US research institutions, leveraging a recently approved EU-Supported Horizon 2020 Marie Skłodowska – Curie RISE Action, on which FORTH and Cambridge already collaborate. They will combine interdisciplinary tools – techniques for astrophysics, polarimetry, space science, with big data science and machine learning, to push stellar astrophysics forward.

In addition to the Cambridge PhD student's scholarship, GAPSTI Impact for Greece will also support visits between Cambridge and Crete for both students and other members of the two groups, to fully explore and strengthen the collaboration.



Above: star trails at the Skinakas observatory, at the top of Ida mountain, central Crete.



Above: An image of the galaxy from the Gaia project.

"Gaia is revolutionising the way we understand stars in our Galaxy," Prof Gilmore of Cambridge said, "by measuring distances for over a billion of them. There has never been a more opportune time to push stellar astrophysics forward, and polarisation is an invaluable piece of this puzzle. Our collaboration with the Institute of Astrophysics in Greece and the unique data they can provide with their state-of-the-art polarimeter at Skinakas Observatory adds scientific value to the billion-euro European investment that Gaia represents."



"The polarisation of stars reveals very important properties about them: whether they have discs or planetary systems around them, and what kind of medium – gas, dust, magnetic fields – lies between the stars and us," Prof Tassis of FORTH explained. "But it is very hard to measure, and so stellar polarisations are, to a very large extent, unexplored. PASIPHAE will measure the polarisation of millions of stars – a thousand times more than we have measured up to now in the parts of the sky where we will look – and with truly unprecedented accuracy." PASIPHAE is supported, among other sources, by the European Research Council.

"The infrastructure of Skinakas Observatory has been jointly supported by the University of Crete and FORTH since its foundation 35 years ago," said Professor Panagiotis Tsakalides, Rector of the University of Crete and head of the Signal

Processing Laboratory at FORTH's Institute of Computer Science, which is also involved in the sophisticated data analysis part of the project. "We are confident that contributing our local infrastructure, signal processing and machine-learning expertise in Crete can provide a substantive support to this exciting project."



"This is the opportunity we were looking for to formalise this valuable scientific synthesis," Professor Vassilis Charmandaris, Director of the Institute of Astrophysics at FORTH commented. "As a newly founded Institute of FORTH, we are paying great attention to scientific excellence. We have every reason to believe that this will be a long-term, flourishing strategic partnership and it will be very beneficial to be exposed to the world-renowned Cambridge Phenomenon GAPSTI is also contributing to."

This collaborative, cross-disciplinary, high-impact research will push the state-of-the-art forward and open up new, unexplored discovery space. Moreover, the new generation of scientists involved in this project are acquiring skills that are also directly applicable and highly sought-after by the private sector.

Impact for Greece: GAPSTI@Greece 2021



The upcoming 200th anniversary of the Greek Revolution of 1821 and the War of Independence is an important remembrance date for Greeks around the world and an opportunity to reflect on the present-day position of Greece and its future.

To mark the event, the Greek state has commissioned the Greece2021 Committee to oversee the planning of the celebration and to organise a comprehensive layout of projects and events that aim to reintroducing Greece, from the beginning of its contemporary history to today, over the course of 200 years. The Committee has invited expressions of interest from individuals and organisations to organise events such as lectures, exhibitions, conferences and talks. Special emphasis is being put to actions having an innovative and forward-looking character, aiming at having a long-lasting impact in the society. The approved events will be placed under the auspices of the Greece2021 Committee and will be included in the national programme of celebrations. They will also be granted permission to use the logo of the Committee.

This call for proposals was perfectly aligned with the remit of the *Impact for Greece* element of GAPSTI. Our intention was to leave a long-lasting footprint of the anniversary, rather than propose an ephemeral event, such as a conference. To this end, GAPSTI proposed to establish at the University of Cambridge, the Greece 2021 Mathematical Legacy Programme and the Greece 2021 Next Generation Modelling Programme.

These two Programmes will initiate long-lasting collaborations between researchers at the University and their counterparts at the Academy of Athens and Greek academic institutions including the National Technical University of Athens and FORTH.



Above: Professor Athanasios Fokas.

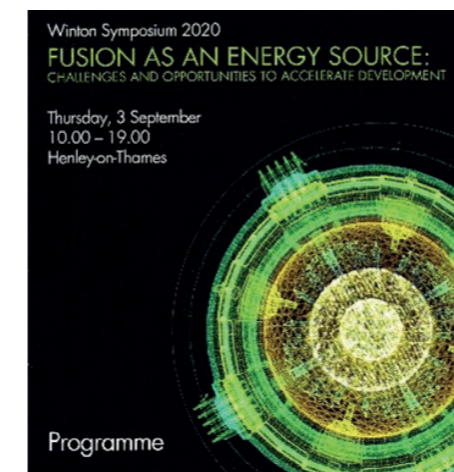
The collaborations will initially focus on the topical areas of precision medicine, clean energy and astrophysics, and they will take the form of joint research projects, exchanges between researchers, jointly supervised doctoral training programmes and technology transfer of the outcomes of this research for the benefit of industry and society. Both of these activities were approved by the Greece2021 Committee and are collectively referred to as GAPSTI@Greece2021.

It is an honour to announce that the Greece 2021 Mathematical Legacy Programme will be conducted under the Directorship of Professor Fokas, the eminent mathematician and member of the Academy of Athens. Professor Fokas has degrees in Aeronautical Engineering (Imperial College), Applied Mathematics (CalTech) and Medicine (Miami). He has written papers and books on symmetries, integrable nonlinear partial differential equations (PDEs), Painlevé equations and random matrices, models for leukemia and protein folding, electro-magnetoencephalography, nuclear imaging, and relativistic gravity. Also, he has introduced a new method for solving boundary value problems known as the Fokas method.

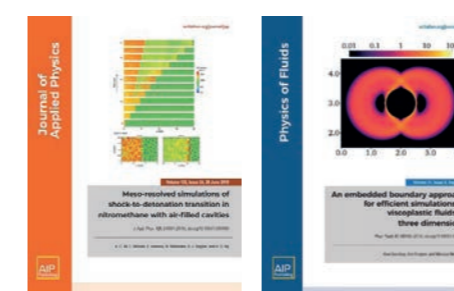
Among his many distinctions, Professor Fokas is the Commander of the Order of the Phoenix of the Hellenic Republic and the recipient of the Naylor Prize (previous recipients include Professor Stephen Hawking and Sir Roger Penrose). Fokas is listed on the ISI Web of Science as one of the most highly cited researchers in the field of mathematics.

The schedule of outreach events and research collaborations led by Professor Fokas will be announced in the months to come and we anticipate an inaugural event in 2021, depending on the prevailing pandemic conditions.

Annual Highlights



Professor Nikiforakis gave an invited talk on 'Multiphysics Modelling of Fusion Reactors' at the Winton Symposium 2020 which, due to the current pandemic restrictions, took place in the garden of David Harding sponsor of the Winton Programme, estate. The title of this year's symposium was 'Fusion as an Energy Source' and was attended by the Vice-Chancellor, Heads of Schools and Departments of the University of Cambridge, the Ambassador and a delegation from the Embassy of the United Arab Emirates, and staff from Tokamak Energy Limited. The day concluded with a panel discussion with industry executives and academics, which explored factors impacting the fusion energy industry.



Two of Professor Nikiforakis's papers, published with his students and postdocs, have been featured on the front cover of

the Journals of *Applied Physics* and *Physics of Fluids*.

The paper on 'Meso-resolved simulations of shock-to-detonation transition in nitromethane with air-filled cavities' (JAPV125, 245901), based on work by XiaoCheng Mi, received the accolades because it explored fundamental physics on the sensitisation of reactive fluids by means of GPU-enabled direct numerical simulation, for a problem that was previously considered to be intractable.

The paper on 'An embedded boundary approach for efficient simulations of viscoplastic fluids in three dimensions', (*Phys Fluids* 31, 093102), based on research by Knut Sverdrup, presented the first-ever fully three-dimensional simulations of creeping flow of Bingham plastics around translating objects. The work was in collaboration with Dr Ann Almgren from Lawrence Berkeley National Laboratory.



Credit: LIYSF.

Dr Gemma Bale and her colleague Professor Clare Elwell gave a lecture on the science and engineering behind brain monitoring at the prestigious London International Youth Science Forum (LIYSF), using live demos and with lively audience participation. They explained how they create optical technology to monitor the brain, both its activity and health, in spaces where conventional brain monitors won't fit, from tracking the brain's development during malnutrition in The Gambia, to searching for biomarkers of newborn brain injury in intensive care, and took an in-depth look into how they are pioneering the future of brain monitoring. LIYSF is a not-for-profit social enterprise established in 1959, which provides students with a deeper insight into STEM and how

science can be applied for the benefit of all humankind. Previous speakers include Professor Lord Martin Rees, the Nobel prizewinner Sir Venki Ramakrishnan and Professor Dame Julia King, the Chair of the Carbon Trust.



Dr Bartomeu Monserrat has been named an 'Emerging Leader 2020' by the Institute of Physics' *Journal of Physics Materials*. *JPhys Materials* has brought together the best early-career researchers in materials science and will publish their exceptional work in an annual collection dedicated to 'Emerging Leaders'. The collection will present key new work across some of the most exciting fields in materials science. *JPhys* defines an emerging leader as 'a top researcher in their field who completed their PhD in 2009 or later'. A limited number of early-career researchers are nominated by the journal's Editorial Boards as the most talented and exciting researchers in their generation.



Dr Hrvoje Jasak received the 2018 Annual Award for Science for his achievements in the field of technical sciences at a ceremony held at the Croatian Parliament on 16 December 2019.

Academic Staff



Prof Nikos Nikiforakis

Nikos Nikiforakis is the Gianna Angelopoulos Professor of Computational Multiphysics at the Cavendish Laboratory (Department of Physics) and the Director of GAPSTI. Nikos is the Head of the Laboratory for Scientific Computing, a research group developing algorithms and high performance computing methods for computational physics. His research interests are problems involving multiple states of matter interacting under extreme conditions. He has a 30-year track record working with companies and government laboratories such as AWE, Boeing, BP, Jaguar Land Rover, ORICA and Schlumberger. Nikos is the Course Director of the Master's in Scientific Computing at the Department of Physics, and a Fellow and Director of Studies in Mathematics at Selwyn College.



Dr Gemma Bale

Dr Gemma Bale is the Gianna Angelopoulos Lecturer in Medical Therapeutics, a joint appointment between the Departments of Engineering and Physics. Gemma holds a BSc in Physics from Imperial College London and a Master's in Photonics Systems Development from the University of Cambridge and University College London. Gemma has established the multidisciplinary research group Neuro Optics Lab, which will develop and validate new optical methods to monitor brain function and metabolism non-invasively. Gemma is a science communicator who has been awarded the Isambard Kingdom Brunel Award for Engineering, Technology and Industry by the British Science Association, and has led the award-winning public engagement platform www.metabolight.org.



Dr Hrvoje Jasak

Dr Hrvoje Jasak is the Gianna Angelopoulos University Lecturer in Scientific Computing at the Cavendish Laboratory (Department of Physics). Hrvoje is a highly experienced high performance computing practitioner and a co-author of OpenFOAM, the world-leading numerical simulation library for computational modelling in continuum mechanics. He has been collaborating with several companies and government research labs worldwide on problems in continuum mechanics, covering a range of models in fluid and solid mechanics, free surface, phase change, electro-chemistry and related phenomena. Hrvoje is the recipient of The National Award of the Republic of Croatia for outstanding scientific achievements. Hrvoje is a Fellow of Christ's College.



Dr Bartomeu Monserrat

Dr Bartomeu Monserrat is the Gianna Angelopoulos University Lecturer in Computational Materials Science at the Department of Materials Science & Metallurgy. Tomeu has a PhD in Physics from the University of Cambridge and has held positions as a PDRA at Rutgers University in the USA, a Henslow Research Fellow and a Winton Advanced Research Fellow at the Cavendish. His research is on the development and use of quantum mechanical methods to investigate material properties for applications such as increasing the efficiency of photovoltaics. His work has been recognised with the 2018 Psi-K Volker Heine Young Investigator Award. Tomeu has been named a 2020 Institute of Physics Materials Emerging Leader. Tomeu is a Fellow of Robinson College.

Operations



Dr Philip Blakely

Dr Philip Blakely provides support for all aspects of high performance computing (HPC) teaching and research related to GAPSTI operations, including research software, hardware and system management. Philip holds a Master of Mathematics and a PhD in Numerical Relativity from the University of Cambridge. He has more than ten years experience as a Research Software Engineer developing large-scale computational multiphysics software for challenging industrial applications. Philip is the Director of the National HPC Academy, which is a two-week intensive course for early-career scientists and engineers. He coordinates the HPC modules for the Master's Degree in Scientific Computing, and lectures.







Samantha Selvini

Samantha Selvini provides administrative and communications support for GAPSTI. Her role includes coordinating activities and events linked to the Programme, including graduate admissions, teaching and research operations, as well as grants and finance management. Samantha is an experienced communications and business management professional with several years' experience working at the Institute for Manufacturing and the Department of Physics at the University of Cambridge. Samantha holds a BSc in Communications and professional qualifications in journalism, copywriting and PR. She is also a qualified Lean practitioner and English language teacher.



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