62ND LONDON INTERNATIONAL YOUTH SCIENCE FORUM 2021

62nd London International Youth Science Forum

28th July – 11th August 2021

'Science for Humanity'

LIYSF CIC

Founded in 1959, LIYSF aims to give a deeper insight into science and its applications, for the benefit of humankind and to develop a greater understanding between young people of all nations.

LIYSF is an accredited not-for-profit social enterprise. We are part of a diverse international network of accredited social enterprises – the Social Enterprise Mark is an independent guarantee that we put the interests of people and the planet above financial gain.

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Professor Clare Elwell: [2018 – Present]

Director
Richard Myhill: [2009 – Present]

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HRH
THE PRINCESS ROYAL

BUCKINGHAM PALACE

As the world starts to emerge from the shadows cast by the pandemic, the vital role that science plays in society has become clear to all. The goal of the London International Youth Science Forum is to bring young students together, to get them directly involved in the fields of science, technology, engineering and mathematics - all areas which have made key contributions to how the world has reacted to the challenges we have, and continue to face.

This year, students will interact both in person and online at this hybrid event. It will present the best of the UK's scientific endeavours - from pioneering scientists explaining their work, to virtual visits to eminent research facilities. Over 15 days, the Forum becomes an international community. This is the start of your journey as you become part of the international science community, and this experience will enable you to foster international friendships and connections, that will help facilitate the growth of your future career.

I welcome you to this 62nd edition and hope that you enjoy and make the most of your time at the Forum over the coming two weeks. Seize every opportunity for scientific or cultural learning, immerse yourself and embrace all the other opportunities presented.

Anne

HRH The Princess Royal
Royal Patron of the London International Youth Science Forum

The Prime Minister
2019 - PRESENT

10 DOWNING STREET
LONDON SW1A 2AA

I am exceptionally pleased to send my greetings to the students, from all over the world, attending the International Youth Science Forum in London this year.

This Forum takes place in the wake of one of the greatest challenges the UK, and indeed the whole world, has ever had to face in the COVID-19 pandemic. It is during this difficult time that we have witnessed how vital science is to our collective health, security, and prosperity. I cannot think of a time in the last 100 years when the entire population of this country has been so deeply and so obviously indebted to science - and to scientists.

In the last 18 months, we have seen heroic acts of science in the swift development of vaccines and treatments to suppress and defeat the virus. Looking forward, we face the looming challenges of abating the impacts of climate change and harnessing new technology to build a green economy.

I hope that the young scientists reading this will find the task of tackling these challenges as an exciting opportunity. We are offering record funding combined with the strongest possible political support and backing for science. We want to inspire the next generation of British scientists and engineers through funding programmes, such as the STEM Ambassadors programme and the CREST Awards. These will help to ensure that young people are encouranged to find and pursure a career in science, and that the vast opportunities and benefits such a career provides are known early on.

Science is a challenging but deeply rewarding endeavour, not just for the individual researcher who makes the discovery - but for the whole society that benefits from it. It is also dependent on people collaborating far and wide to bring in the right knowledge and talent. That is what makes this forum so valuable for young scientists looking to exchange ideas.

Boris Johnson
The Prime Minister

LIYSF
WELCOME MESSAGE

It is with great pleasure that we welcome you to the 62nd London International Youth Science Forum, our first ever hybrid event.

The theme for this year's Forum is *Science for Humanity*, reflecting the unprecedented efforts we have seen from the scientific community as the world faces the challenges of the COVID-19 pandemic. Now more than ever before, we see the importance of innovation, interdisciplinary collaboration and global partnerships – all of which echo the core tenets on which LIYSF was founded over six decades ago.

Whether you are joining us in person or online during the next two weeks, the Forum will give you the opportunity to engage with world-leading scientists and learn about their cutting-edge work. You will be encouraged to debate, communicate and challenge scientific ideas. And in the true spirit of the Forum, you will interact and share these experiences with other young scientists from over 50 countries across the globe.

Use your time at the Forum to expand your knowledge, investigate new ideas and make connections – you are surrounded by the future of science and a network which will support you for the rest of your lives! Get involved and make the most of this life-changing opportunity.

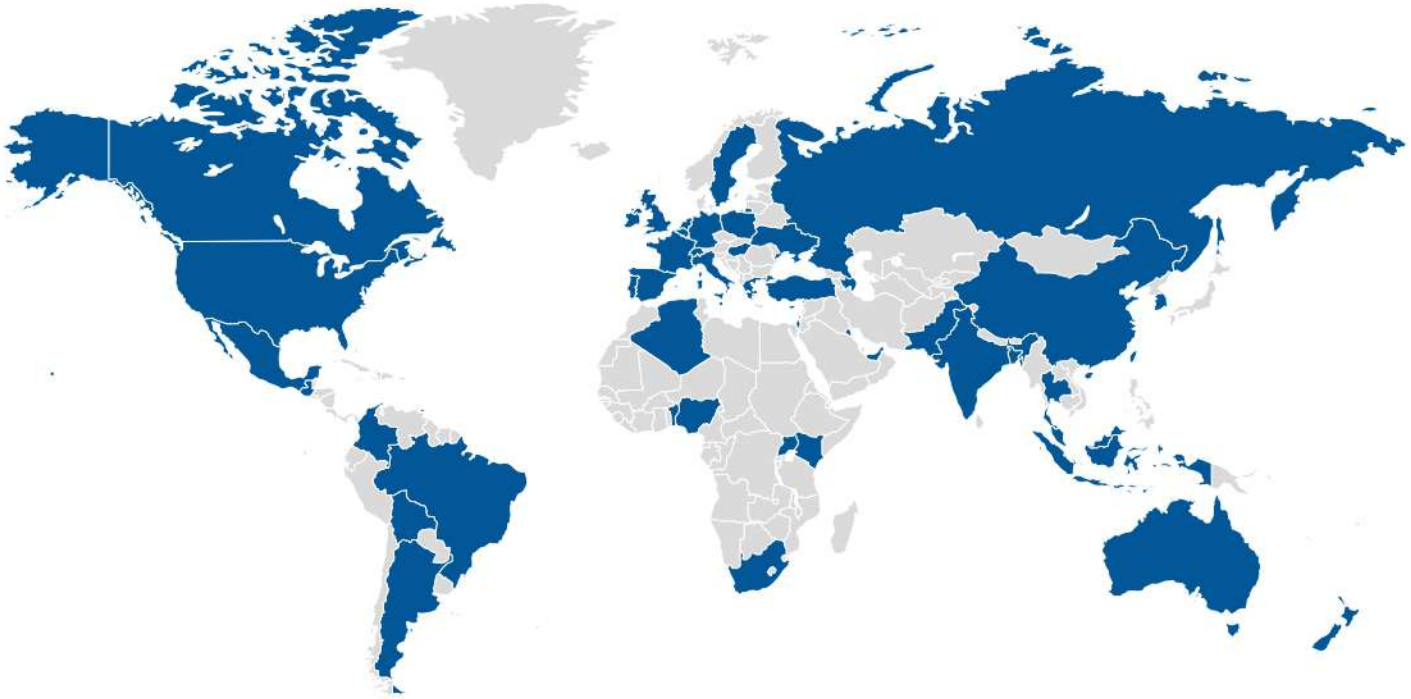
Everyone is welcome at LIYSF and we are thrilled to have you with us. You are now part of a special family.

Let's change the world!

Professor Clare Elwell
President, LIYSF

Richard Myhill
Director, LIYSF

Represented Countries & Territories



Algeria
Argentina
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Channel Islands
China
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Curacao
Cyprus
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Germany
Greece
Guatemala
Hungary
India
Indonesia
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Kuwait
Luxembourg
Malaysia
Malta
Mexico
Monaco
Netherlands
New Zealand
Nigeria
Pakistan
Poland
Portugal
Republic of Korea
Republic of Singapore
Russia
South Africa
Spain
Sweden
Switzerland
Taiwan (ROC)
Thailand
Trinidad and Tobago
Turkey
Uganda
Ukraine
UAE
UK
USA

Schedule

	Morning	*Afternoon*	*Evening*
Wednesday 28th July		Arrivals	Welcome
Thursday 29th July	Opening Ceremony & Keynote Address – **Professor Dame Sarah Gilbert** & LIYSF President Welcome – **Professor Clare Elwell**	Principal Lecture Demonstration – **Professor Nick Jennings CB**	Welcome Event
Friday 30th July	Visit to Research & Scientific Establishments in London	Principal Lecture Demonstration – **Dr. Maggie Aderin-Pocock MBE**	Great Crossword Treasure Hunt
Saturday 31st July	Principal Lecture Demonstration – **Dr. Diane Ashiru-Oredope**	**The Science Forum Bazaar** – Student Project Poster Board Event	Rounders in Hyde Park
Sunday 1st August	Optional Visit to Stonehenge	Optional Visit to Stonehenge	Debate Evening
Monday 2nd August	Specialist Lectures	Principal Lecture Demonstration – **Professor Valerie Gibson**	Present the scientist that inspires you in fancy dress!
Tuesday 3rd August	Day Visit to Research & Scientific Establishments	Day Visit to Research & Scientific Establishments	Guided London Walking Tour
Wednesday 4th August	Specialist Lectures	Specialist Lectures	LIYSF Memorial Lecture – **Professor Pete Vukusic**
Thursday 5th August	Day Visits to Oxford Research and Scientific Establishments	Day Visits to Oxford Research and Scientific Establishments	Rehearsals
Friday 6th August	Specialist Lectures	Principal Lecture Demonstration – **Professor M. Saiful Islam**	**International Cabaret** and **Traditions of Home** – Cultural Showcase Performance Evening
Saturday 7th August	Principal Lecture Demonstration – **Professor Fiona Watt**	Principal Lecture Demonstration – **Dr. Andrew Szydło**	Scientific Vist to the Science Museum
Sunday 8th August	Day visit to Cambridge	Day visit to Cambridge	Rounders in Hyde Park
Monday 9th August	Specialist Lectures	Specialist Lectures	Optional London Coach Tour
Tuesday 10th August	Keynote Lecture – **Professor Lord Martin Rees**	Closing Keynote Lecture – **Professor Dame Julia King** & Ceremony	**"Funlympics"** (outdoor sporting extravaganza)
Wednesday 11th August	Departures		

Principal Lectures & Demonstrations

Keynote Address
Making a vaccine against SARS-CoV-2

Professor Sarah Gilbert

University of Oxford

At the end of 2019, a virus which had not been identified previously began to cause infections in humans. Within days, Sarah Gilbert's team at the University of Oxford had begun planning to make a vaccine against that virus. Now the vaccine is in use in 172 countries, and half a billion doses have been delivered. The lecture will address how this project got started.

Sarah Gilbert is the Saïd Professor of Vaccinology at the University of Oxford. She works on vaccines for many different emerging pathogens, including influenza, Nipah, MERS, Lassa, Crimean-Congo haemorrhagic fever, and in 2020, she initiated the SARS-CoV-2 vaccine project. Working with Oxford colleagues she is able to take novel vaccines from design to clinical development, with a particular interest in the rapid transfer of vaccines into manufacturing and first in human trials. She is the Oxford Project Leader for ChAdOx1 nCoV-19, a vaccine against the novel coronavirus, SARS-CoV-2 which is now in use in many countries around the world.

29th July
Human Artificial Intelligence Partnerships

Professor Nick Jennings

Imperial College London

In our increasingly connected world, computation is everywhere and we are generating ever more data about everything. These trends will profoundly change the ways in which we work with computers. Specifically, we need the machines to be smarter and more helpful. Central to this vision is the means by which we can forge effective partnerships with such artificial intelligence (AI) systems. Until now, humans have generally been the masters and technology the slave. This needs to change. Today's AI systems can act on high-level human commands and achieve complex goals in a flexible manner. But, while such systems are good at solving narrowly defined tasks, they don't know how to collaborate with humans or how to operate as part of a problem-solving team. This talk will explore how humans and AI systems can work together. In such partnerships, the humans and the AI systems complement each other's strengths and weaknesses, leading to a rise in the humans, as well as in the machines.

Professor Nick Jennings CB, FREng is the Vice-Provost for Research and Enterprise and Professor of Artificial Intelligence at Imperial College London. He is an internationally-recognised authority in the areas of AI, autonomous systems, cyber-security and agent-based computing. He is a member of the UK Government's AI Council, the governing body of the Engineering and Physical Sciences Research Council, and chair of the Royal Academy of Engineering's Policy Committee. Before Imperial, Nick was the UK's first Regius Professor of Computer Science (a post bestowed by the monarch to recognise exceptionally high quality research) and the UK Government's first Chief Scientific Advisor for National Security.

30th July
REACHING FOR THE STARS - THE POWER OF A CRAZY DREAM

Dr Maggie Aderin-Pocock MBE

University College London

Since childhood, Dr Maggie has been looking out into space with wonder. Inspired by programs such as Star Trek, she has wanted to get out there but will this ever be possible? Through this talk, Dr Maggie explores the edge of astronomical knowledge and looks at what is to come, when will humans in space be the norm?

Dr Maggie Aderin-Pocock is a space scientist and science communicator. She studied at Imperial College London, where she obtained her degree in Physics and her Ph.D. in Mechanical Engineering. She has spent her career making novel, bespoke instrumentation in both the industrial and academic environments. To further share her passion for science, Maggie founded "Science Innovation Ltd". Through this, she conducts public engagement activities, sharing her love of space. To date, Maggie has directly spoken to over 350,000 people around the world. As well as public speaking, she is an author and TV presenter, and co-hosts the world's longest-running science television program "The Sky at Night".

31st July
ANTIMICROBIAL RESISTANCE: THE SILENT PANDEMIC? WHY YOU SHOULD CARE.

Dr Diane Ashiru-Oredope

Public Health England

In 2019, the World Health Organization declared antimicrobial resistance (AMR), one of the ten global health threats facing humanity. The COVID-19 pandemic has given us an example of how life without effective treatment for an infection could be. Although a couple of treatment options have been found useful in the management of the infection in hospitalised patients, the best measure for COVID-19 and infections caused by microorganisms resistant to medicines is to prevent the infection in the first instance. In this lecture, you will find out the scale of the problem and what you can do to protect yourself, your family, friends and future patients (if you go on to become a healthcare professional) against the spread of antimicrobial resistance.

Dr Diane Ashiru-Oredope is the Global AMR lead for the Commonwealth Pharmacists Association and the Lead Pharmacist for the Antimicrobial Resistance (AMR) and Healthcare Associated Infections, Public Health England. An antimicrobial pharmacist by background, she has significantly contributed to or led several multicountry and international projects and workshops on tackling antimicrobial resistance including assessing knowledge, attitudes and behaviours of healthcare workers, as well as developed relevant training. She leads the international Antibiotic Guardian campaign, now in its sixth year and is underpinned by behavioural science.

In 2015, Dr Diane Ashiru-Oredope was awarded Public Health Pharmacist of the year and in 2016, Outstanding Woman in the Public Sector at the 10th PRECIOUS awards. She was appointed a Fellow of the Royal Pharmaceutical Society of Great Britain in February 2017. She has been nominated and delivered TEDx talks at TEDxNHS and TEDxLondonBusinesSchool

2ND AUGUST
BEAUTY AND THE BEAST: MATTER, ANTIMATTER & THE LARGE HADRON COLLIDER

Professor Valerie Gibson OBE

University of Cambridge

The Large Hadron Collider (LHC) is one of the wonders of the modern world - a true beast of a creation consisting of a 27-kilometer ring of superconducting magnets with an accelerating system to boost the energy of particles along the way. The ultimate aim of the LHCb (beauty) experiment is to search for new phenomena in heavy quark (beauty and charm) systems - which could explain why we live in a universe made of matter and not antimatter, and provide insight into its very origins. This lecture will highlight news from the LHC, the latest discoveries and the first glimpse of phenomena beyond our current understanding of the universe.

Professor Valerie Gibson has spent her career undertaking high energy particle physics research at CERN and championing women in science. She is Head of the High Energy Physics Research Group at the Cavendish Laboratory, University of Cambridge. She holds a Special Honours BSc in Physics from the University of Sheffield, a DPhil in Experimental Particle Physics from the University of Oxford, and was a Fellow in the Experimental Physics Division at CERN. She came to Cambridge as an SERC Advanced Fellow and was appointed as the Stokes Senior Research Fellow at Pembroke College. She was appointed as University Lecturer and Fellow of Trinity College in 1994. She held a Royal Society Leverhulme Trust Senior Fellowship and became a Professor in 2009. Val has been the UK Spokesperson for the LHCb experiment at CERN and had the ultimate responsibility to deliver the UK contributions to the experiment. She is currently the Chair of the LHCb Collaboration Board, with representatives from 78 institutes across the world. She is the University of Cambridge Gender Equality Champion for the STEM subjects. She was awarded an OBE in the 2021 New Years Honours for services to science, women in science and public engagement.

4TH AUGUST
ALL THINGS BRIGHT: USING INSPIRATION FROM THE LIVING WORLD

Professor Pete Vukusic

University of Exeter

Using demonstrations and live activities, award-winning scientist and science communicator Pete Vukusic will describe how the exciting discipline of bio-inspiration is leading directly to new technologies and devices, and is shedding light on the wonder of the natural world.

Pete Vukusic is a Professor of Physics and a Dean for Education at the University of Exeter. He spent his school days at St. Joseph's College in South London, and his university days at Exeter and at Imperial College, London. He is a qualified teacher and taught for many years at schools in Taunton and in Marlborough. Since 2001, Pete has led the Biological Photonics research group at Exeter. The group's aims are to try to understand biological strategies that are at work in the manipulation of light and the creation of the appearances of animals and plants, then to apply these strategies for the design or improvement of useful technologies. Pete has been communicating science to the public and delivering science outreach to students and adults in the UK, the EU, the US and across Africa since his early days as a teacher in schools. He is an Institute of Physics Schools lecturer and a Royal Society award winner for science communication.

In memory of Tim Rooke, who supported LIYSF over a number of years, becoming a great friend and supporter of the Forum. We are truly very thankful for his contribution and miss him terribly. Tim was also the co-founder and trustee of the charity Young Scientists for Africa (YoSA) which supports African students in attending LIYSF. This cause was incredibly close to Tim's heart and he loved the positive change the charity is making in providing opportunities for gifted African science students.

6th August
MAKING A MATERIALS DIFFERENCE TO GREEN ENERGY

Professor M. Saiful Islam

University of Bath

The supply of low carbon energy is one of the greatest challenges of our time. Major breakthroughs in clean energy technologies require advances in new materials and underpinning science. This talk highlights where we are with novel lithium battery materials for electric vehicles and perovskite compounds for solar cells, and how combined modelling-experimental techniques can provide new atomic-scale insights.

Saiful Islam is Professor of Materials Chemistry at the University of Bath. He grew up in London and obtained his degree and PhD from University College London, followed by a Postdoctoral Fellowship at the Eastman Kodak Labs, New York. His research encompasses modelling of materials for lithium batteries and solar cells. Recent awards include the 2020 American Chemical Society Award for Energy Chemistry. Saiful presented the 2016 Royal Institution Christmas Lectures for BBC TV on the theme of energy. He is a Patron of Humanists UK and when not exploring new materials, he enjoys family breaks (as a dad of two), football and indie music.

7th August
UNDERSTANDING CELL HETEROGENEITY IN MULTI-LAYERED EPITHELIA

Professor Fiona Watt

King's College London

Advances in single cell technologies such as RNA-sequencing provide new opportunities to understand the cellular heterogeneity of different tissues. The Human Cell Atlas is a global initiative to create a comprehensive reference map of all human cells in the body as a basis for understanding human physiology in health and disease, collaborating to study human skin from healthy donors and patients with psoriasis or atopic dermatitis. Our analysis is providing new insights into the nature of the epidermal stem cell compartment. With the help of mechanistic studies, we are starting to gain new understanding of this fascinating tissue. Specifically, the existence of different subpopulations of stem cells, which was predicted from clonal analysis of cultured human epidermal cells, is confirmed by Human Cell Atlas data. In addition, the nature of the transition from stem to differentiated cell and the role of protein phosphatases in that transition are consistent with single cell RNA sequencing datasets.

Fiona Watt obtained her DPhil from the University of Oxford and carried out postdoctoral research at M.I.T., Cambridge, USA. She established her first lab at the Kennedy Institute of Rheumatology in London and then moved to the London Research Institute. From 2006 to 2012, she was Deputy Director of the Cancer Research UK Cambridge Research Institute and Deputy Director of the Wellcome Trust Centre for Stem Cell Research, University of Cambridge. She moved to King's College London in September 2012 to take up her current position as the Director of the Centre for Stem Cells & Regenerative Medicine. Since April 2018, Fiona has been on secondment as the Executive Chair of the Medical Research Council in the UK. The major research interest of Fiona Watt's lab is in the interplay between internal and external factors in the regulation of stem cell fate.

7th August
HISTORICAL HIGHLIGHTS OF CHEMISTRY

Dr Andrew Szydło

Highgate School

This lecture will look to insights into historical aspects of chemistry, considering this branch of science and how it has evolved over the ages. The lecture will consider; early ideas of the elements – Chinese, Arabic, Ancient Greek; the alchemists and their belief in transmutation; some insights into the history of the discovery of oxygen; the states of matter, particles, energy, the liquefaction of gases and the discovery of fluorine, and redox chemistry of the halogens.

Andrew Z. Szydło has a PhD in the History and Philosophy of Science (University College, London), and is an expert on the history of alchemy. His book *"Water Which Does Not Wet Hands"* (1994) is considered to be the standard reference work on the Polish alchemist, Michael Sendivogius. He is an internationally acclaimed teacher and demonstrator of the chemical sciences and teaches at Highgate School in North London.

10th August
PLANETS, STARS AND GALAXIES

Lord Rees of Ludlow

UK Astronomer Royal

Astronomers have sent probes to all the main objects in our Solar System and have learnt about the life-cycle of stars. We've learnt, too, that most stars are orbited by planets, just as our sun is orbited by the Earth and the other familiar planets. Powerful telescopes can observe millions of galaxies, each as large as our own Milky Way, and the black holes lurking their centres. Two big questions are: Did everything begin in a big bang? Is there life, even intelligent life, elsewhere in the cosmos?

Martin Rees is the UK's Astronomer Royal and a professor at Cambridge University. He has conducted influential theoretical work on subjects as diverse as black holes, gamma ray bursts, dark matter, and the formation of galaxies. He speaks and writes on general scientific topics and is the author of ten books, the most recent being 'On the Future'. Prospects for Humanity and 'Gravity's Fatal Attration' (third edition).

10th August

NET ZERO – WHY IS IT SO IMPORTANT AND HOW DO WE GET THERE?

Professor Dame Julia King

House of Lords

The world is already 1.2°C warmer than pre-industrial times, and the Paris agreement commits countries to try and keep temperature rise by the end of the century down to as close to 1.5°C as possible. To achieve this, we are going to have to act fast. Why is it so important and so urgent? We are already seeing the global impacts of the changing climate: 2020 concluded the warmest 10 year period on record; 2016 was the hottest year ever recorded; in 2018 wildfires in the US burned more than twice the area they did in 1970, and the average wildfire season is now 78 days longer; on the eastern coast of the US, six of the seven largest hurricanes, tropical storms and floods occurred in the last 20 years. Research published in 2019 showed that climate extremes, such as drought, heatwaves and heavy precipitation are responsible for up to 43% variation in crop yields for maize, spring wheat, rice, and soybeans. If we continue as we are, the world could warm by an average of as much as 4°C by 2050, with dramatic effects on weather, drought, flooding, food availability, conflict, migration, wildlife – leaving parts of our world uninhabitable. Taking the UK as an example, and the historic Climate Change Act of 2008, the lecture will look at the local impacts of climate change, the rationale for committing to achieve Net Zero emissions by 2050 and the ways this can be achieved, highlighting key role of science and engineering in: understanding the problem; developing good policy; and delivering the solutions.

Baroness Brown is an engineer and a Crossbench Member of the House of Lords, with extensive experience in industry and academia. Julia was Vice Chair of the Climate Change Committee for 12 years and continues to advise the UK Government as Chair of the Adaptation Committee of the CCC and as a member of the Hydrogen Advisory Council. She chairs The Carbon Trust and is a non-executive director of the Orsted. Until its sale in 2017, she was a non-executive director of the Green Investment Bank. She led the King Review on decarbonising transport (2007) for the Chancellor of the Exchequer.

2.1
THE CASSINI/HUYGENS SPACECRAFT MISSION TO SATURN AND ITS MOONS

Professor Michele Dougherty CBE

Imperial College London

In September 2017, the NASA/ESA Cassini-Huygens spacecraft mission ended its 20 years in space by burning up in Saturn's atmosphere. The end of mission orbits were designed to better understand the interior of Saturn and its very surprising axisymmetric planetary magnetic field. Many surprising discoveries were made during the orbital tour of Saturn, including water vapour plumes at the small moon Enceladus and implications this has for potential habitability; ice volcanoes and liquid ethane/methane on Titan's surface; and liquid water oceans below the surface of both of these moons. Saturn's aurorae were studied in more detail than ever before, utilising both in-situ and remote observations, and an understanding gained of the environment around Saturn filled with plasma and energetic particles. Some of these highlights will be described as well as touching briefly on the next large planetary mission, JUICE, going to Jupiter and its moons due for launch in August 2022.

Michele Dougherty is Professor of Space Physics at Imperial College London. She is leading unmanned exploratory missions to Saturn and Jupiter and was the Principal Investigator for the magnetometer instrument onboard the Cassini mission to Saturn as well as being the Principal Investigator the magnetometer for the JUpiter ICy moons Explorer (JUICE) of the European Space Agency due for launch in 2022. She is Head of the Physics Department, is a Fellow of the Royal Society, was awarded the Royal Astronomical Society Geophysics Gold Medal in 2017, was awarded a CBE in the 2018 New Year's Honours List, and was awarded the Institute of Physics Richard Glazebrook Gold Medal and Prize.

2.2 GENETIC TESTING – DO YOU REALLY WANT TO KNOW?

Dr Emma Yhnell

Cardiff University

Genetic testing is becoming more common in mainstream society, through the growing popularity of various commercial organisations. There are important differences between the commercial genetic tests which can be completed at home and the genetic tests available through healthcare providers such as the NHS. Join Dr Emma Yhnell who will explore some of the complex dilemmas which genetic testing creates. Emma will focus on a recent legal challenge which was centred around her research area of Huntington's Disease. Huntington's Disease is a rare neurodegenerative condition which is caused by one faulty gene and therefore a genetic test exists for the condition. In this interactive session, we will consider some of the complex ethical, moral and societal challenge which arise as a result and the audience will be challenged to consider their own views on genetic testing.

Emma obtained a BSc degree in Biochemistry at Cardiff University before completing a PhD exploring Huntington's Disease (HD) in the laboratory. She then obtained a research to translate her findings on cognitive training into the HD patient clinic. Her work looked to see if computerised brain training is feasible for people impacted by Huntington's disease. Emma now works as a Lecturer at Cardiff University, teaching the next generation of budding scientists. In addition to her research and teaching, Emma is an award-winning science communicator. She has given prestigious talks including TEDx and at international science festivals. She is a regular contributor to local radio and television and a published author, currently working on her first solo book.

2.3 BLOOD CANCER, IMMUNOTHERAPY & COVID OPPORTUNITIES & CHALLENGES

Dr Kate Cwynarski – LIYSF 1983

University College Hospital, London

Dr. Kate Cwynarski attended LIYSF in 1983 and has so many fantastic memories from those two weeks in London. Her talk will look to her work as a blood cancer doctor specialising in Lymphoma and Immunotherapy at University College Hospital, London. The lecture will cover the many impressive developments and discoveries made over the last 30+ years that have revolutionalised the treatment options available for patients. Kate works closely with many other colleagues working in organ transplantation, immunodeficiencies and neurosurgery and will also discuss insights gained from their collaborative working. COVID has also had a huge impact on the care of patients. Kate in her own words, "feels privileged to work in this field and I'm grateful for the inspiration I gained in the summer of 1983".

Dr. Kate Cwynarski is a Haem-Oncologist specialising in Lymphoma and chronic lymphoid leukaemia at University College London Hospital, London, UK. She trained at King's College, Hammersmith Hospital and Royal Free Hospital, London UK and received her MRC-funded PhD in immunology at Imperial College, London, UK. Her sub-specialist interests include Central Nervous System Lymphoma, HIV-related lymphoma, Post-transplant lymphoproliferative disorders and CAR-T. She leads the UK CNS Lymphoma Group and is a member of the British Society of Haematology Lymphoma Specialist Interest Group and National Cancer Research Institute Lymphoma Clinical Studies Group. Dr. Cwynarski is involved in many clinical trials, has co-authored BCSH guidelines and she has authored or co-authored over 80 journal articles in Lancet Haematology, Journal of Clinical Oncology, Blood, AIDS, British Journal of Haematology and Bone Marrow Transplant.

Wednesday 4th August – Specialist Lectures

4.1 Engineering for the Future

Jameer Emmamally – LIYSF 2003

UK Atomic Energy Authority

How do discoveries made today become tomorrow's reality? How does science move from the classroom to something you can touch and feel, or something that can help you solve a problem, investigate an idea, meet the needs of a city, a person or a company? This interactive lecture will give you an introduction to engineering and an awareness of the design process as we go on a brief journey to take an idea from concept to reality.

Jameer Emamally attended LIYSF 2003. Jameer is a Chartered Engineer working for the United Kingdom Atomic Energy Authority. He graduated from Imperial College London where he completed his Master's degree in Aeronautical Engineering. He has held various positions where he worked at both the national and international level with Government and the private sector. Jameer has project managed complex teams to deliver high integrity fission and fusion related systems.

4.2 Searching for New Physics with ATLAS at the Large Hadron Collider

Dr Kate Shaw

University of Sussex

The Large Hadron Collider results have changed the landscape of particle physics where new particles and interactions are being investigated. With the third run of the machine to start in Spring 2022, we hope to see new clues to answer fundamental questions about the Universe, such as what is dark matter, how we can understand the asymmetry between matter and antimatter, and how can we describe gravity at a quantum level? This talk will investigate how and why we are searching for New Physics, what it might mean when we do, and look at the benefits to humanity this massive machine may bring.

Kate Shaw is an experimental particle physicist at the University of Sussex, UK, working on the ATLAS experiment at the Large Hadron Collider, and the Deep Underground Neutrino Experiment (DUNE) at Fermilab, where her field of research focuses on searching for New Physics. Shaw is also a staff scientist at the Abdus Salam International Centre for Theoretical Physics (ICTP), Italy, a UNESCO institute where she founded and co-coordinates the ICTP Physics Without Frontiers programme.

4.3 CHEMICAL ENGINEERING AND THE ENERGY TRANSITION

Dr Ollie Folalyan

Cleofol Enterprises Ltd / AFBE

The design and operations of processes that produce and/or utilise energy are fundamental aspects of chemical engineering but with the move towards cleaner energy sources how will the role of chemical engineers evolve? In this lecture, Dr Ollie Folayan will discuss the ways in which chemical engineers are offering key solutions to achieving Government's net zero targets whilst ensuring that energy needs continue to be met. From the utilisation of carbon capture technologies to the progressive replacement of fossil fuels and the introduction of renewable energy sources (RES) and alternative carbon feeds.

Ollie Folayan is a chartered chemical engineer working in the energy industry and co-founder of AFBE-UK. Ollie graduated with a BEng in Chemical Process Engineering with Fuel Technology from the University of Sheffield in 1999 and then earned a Doctorate (PhD) in Fuels and Combustion from the University of Leeds in 2002, authoring five international publications in the field of combustion and engineering. To date Ollie has worked on Major CAPEX front end engineering design, detailed design, and commissioning projects. In 2018, Ollie Folayan was accepted into the Fellowship of the Institution of Chemical Engineers.

4.4 STEM CELL RESEARCH: MARRIAGE BETWEEN BASIC SCIENCES & BIOINFORMATICS

Professor Florence Adekunle

Ladoke Akintola University of Technology

The advent of stem cell research has brought a lot of hope for patients and their relations. The research which has been used to bring something out of what you cannot see, has brought a cure to quite a number of devastating diseases of our time. This research facilitates the utilization of computational approaches and mathematic models, to explain biological phenomena observed, and the prediction of the outcome under conditions not yet experimentally tested. The predictions from the models facilitate targeted clinical applications in regenerative medicine which makes its application a success.

Professor Adekunle obtained a Bachelor of Technology (Hons) at Ladoke Akintola University of Technology, Nigeria. She has had roles at Ladoke Akintola University of Technology and the University of Ibadan, where she obtained Master of Science and Doctor of Philosophy degrees. She is a recipient Third World Academy of Science (TWAS) fellowship, which she utilized at the Indian Association for the Cultivation of Science (IACS) in Kolkata, India. She has been a visiting professor at Howard University USA. Professor Adekunle, who is a Fellow of the Chemical Society of Nigeria (FCSN), Fellow Institute of Chartered Chemists of Nigeria (ICCON), also belongs to several professional associations, among which is the American Chemical Society (ACS).

6.1

TOWARDS TREATMENTS FOR DEMENTIA AND MOTOR NEURON DISEASE: THE POWER OF GENETICS AND STEM CELLS

Dr Rubika Balendra – LIYSF 2004

University College London

The health and socioeconomic burden of dementia is vast, and will only increase over the next few decades. Motor Neuron Disease is a devastating neurodegenerative disease which affects one in 250 people. How will we move towards finding treatments for these diseases? This lecture will discuss recent developments in this field of neurodegeneration with a focus on using genetics to drive forwards our understanding of mechanisms and therapeutics. We will discuss novel disease models, including human stem cell-derived neurons and fruit flies, as approaches to investigate clinically applicable pathways in neurodegeneration.

Rubika is a Specialist Registrar doctor in Neurology in London. She recently completed a PhD as a Wellcome Trust and UCL Leonard Wolfson Research Training Fellow investigating Motor Neuron Disease and frontotemporal dementia at the UCL Institute of Neurology. She read medicine at Cambridge University and UCL. She trained in clinical and academic medicine as an Academic Clinical Neurosciences Foundation Trainee at Cambridge University. She continued clinical and academic training as an Academic Clinical Fellow at Kings College London. She enjoys teaching science and medical students and is actively involved in public engagement in science. She was an LIYSF participant in 2003 and a staff member from 2004-2007.

6.2 IS THIS MY HEART?

Dr Tom Ingram – LIYSF 1993

Royal Shrewsbury Hospital

Examine one of the world's biggest killers - ischaemic heart disease reflecting upon the evolution of our understanding of angina and heart attacks. We will look at the pathology, the treatment and the complications which can occur. Then we will look to the future, on the one hand exploring the exciting therapies of stem cell transplantation and reperfusion injury limitation. However, an appreciation will also be given as to why, despite the significant advances we have made, the rate of decline in the incidence of heart disease has slowed and may even be on the rise again. The worrying prediction that this could be the first generation to be outlived by their parents should sharpen all of our minds as we enter an uncertain future.

Tom Ingram is a Consultant Cardiologist working in the West Midlands region of the United Kingdom. He graduated from the University of Leeds in northern England. He was selected onto the All Wales specialist training programme in Cardiology. Most recently, he has been awarded a three year competitive research grant from the British Heart Foundation to look into blood flow characteristics during times of reduced oxygen supply to the heart. He was an attendee at the Forum in 1993 and then returned as a member of staff for four years.

6.3 MEDICAL IMAGE ANALYSIS: HOW AI IS AUGMENTING DIAGNOSIS

Dr Matt Sinclair – LIYSF 2004

Heartflow

In recent years, advances in machine learning applied to image and video analysis have revolutionised applications across many domains, including but not limited to autonomous vehicles and drones, video streaming, facial recognition, and medical image analysis. In this talk, we will explore how AI is impacting the way in which medical images are being used to aid and improve medical diagnosis. A broad introduction on AI in computer vision will first be presented, and then we will look at several applications in medical imaging, including work we are doing at HeartFlow to improve outcomes for patients with coronary artery disease.

Matthew is a Research Scientist at HeartFlow, working on deep learning and computational fluid dynamics to assess coronary artery disease in patients non-invasively. He is also an Honorary Research Fellow at Imperial College London, where his research focuses on automating and aiding clinical assessment of medical image data, particularly fetal ultrasound and cardiac MRI. He graduated from the University of Auckland in 2009 with a Bachelor of Biomedical Engineering and received his PhD from Kings College London in 2014, where he worked on the analysis of blood flow distribution in the coronary circulation.

Monday 9th August – Specialist Lectures

9.1 Water Repellent Surfaces - Learning From Nature

Professor Claire Carmalt

University College London

Extremely water-repellent (superhydrophobic) surfaces cause water to ball into tight droplets, which on rolling about on the surface, pick up dirt, viruses and bacteria, cleaning it without any scrubbing. Inspired by nature, such as the water repelling properties of lotus leaves, superhydrophobic surfaces have been developed. The biggest challenge for the widespread application of such surfaces is finding a way to make them tough enough to withstand everyday damage. These surfaces tend to be mechanically weak and rub off easily, but use of adhesives/polymers, allows robust self-cleaning surfaces to be designed making them effective even after being scratched, scuffed or exposed to oil.

Professor Claire Carmalt obtained her BSc and PhD from the University of Newcastle upon Tyne. She was then a postdoctoral fellow at the University of Texas at Austin, USA. She has worked at UCL since 1997 (1997-2002: Royal Society Dorothy Hodgkin Fellowship and Lecturer; 2002-4: Senior Lecturer; 2004-9: Reader; 2009: (Professor). In 2016, she became the 18th Head of Department for Chemistry and the first woman appointed to the position. In 2019, she was awarded the Royal Society of Chemistry Applied Inorganic Chemistry Award and in 2021, she received a One UCL Leadership Award for Outstanding Contribution.

9.2 Materials Science for Better Solar Generation of Electricity

Dr Ruy Sebastian Bonilla

University of Oxford

Climate change is one of the defining challenges of the next 30 years. In order to move to a low-carbon future, and avoid the worst effects of climate change, continuing reductions in the cost of renewable energy and electricity are required. One of the most important forms of renewable energy is photovoltaics, producing electricity from sunlight. Sunlight is freely available across the globe, and can be scaled from single panels for lighting in developing countries to rooftop installations for powering residential homes, to utility-scale plants feeding megawatts of power into national electricity grids. At the Oxford Materials Department, we aim to understand and develop new materials that enable a new generation of higher performing solar panels. Materials science has enabled a revolution in the production of better and more efficient panels. This talk will give an introduction to solar energy, focusing on how solar cells work, and how our research at Oxford is bringing improvements to the efficiency of solar panels worldwide.

Sebastian received a Bachelor's degree in Electrical and Electronics Engineering from Universidad de los Andes, Colombia, 2008. He completed an MPhil degree in Micro and Nanotechnology at the University of Cambridge, UK, in 2010, and a Doctorate in Materials funded by a Clarendon Scholarship in 2015, researching novel methods to improve silicon solar cells. After, he was awarded an Research Fellowship to deepen the understanding and advance industrial deployment of his research. At the same time, he became Junior Research Fellow at Wolfson College, Oxford. From 2019, he is a Royal Academy of Engineering Research Fellow in the Oxford Materials Department. Since 2021, he is a Stipendiary Lecturer in Materials Science at St Anne's College, Oxford.

9.3 SURFACES AND STRINGS

Professor Ulrike Tillmann

University of Cambridge

Surfaces and their higher dimensional analogues are fundamental objects in geometry and topology. We will look at how ideas from quantum field theory and string theory have inspired mathematicians to have a fresh look at them. Starting with the Euler characteristic, we will introduce the notion of a cobordism and the work of Thom (for which he gained a Fields Medal). We then explain how the same notion of cobordism comes up in string theory and quantum field theory in the work of Witten and Atiyah.

Professor Ulrike Tillmann has worked broadly in topology, K-theory, and non-commutative geometry. Her work on the moduli spaces of Riemann surfaces and manifolds of higher dimensions has been inspired by problems in quantum physics and string theory, while new challenges in data science have motivated some of her recent work. After finishing school in Germany, Tillmann went to Brandeis University, USA, and studied for her PhD at Stanford University, USA. Before she took her present position at the Univerisity of Oxford, she was a post-doc in Cambridge, UK. This autumn she will be the Director of the Isaac Newton Institute in Cambridge and the President of the London Mathematical Society. Tillmann was awarded the Whitehead Prize by the London Mathematical Society in 2004 and the Bessel-Humboldt Forschungs Preis in 2008. She was elected a fellow of the Royal Society in 2008, an inaugural fellow of the American Mathematical Society in 2012, and a member of the Leopoldina in 2017. She is a fellow of the Alan Turing Institute.

9.4 CRISPR CAS9 – FROM DISCOVERY TO THE NEW ERA OF GENOME EDITING

Professor Malcolm White

University of St. Andrews

All living things are attacked by viruses. This has resulted in the evolution of many different defence systems, such as the human innate and adaptive immune systems. CRISPR is a bacterial adaptive immune system that detects and destroys viral invaders. CRISPR Cas9 was discovered in 2012 and can be easily programmed to cut any desired DNA sequence, leading to the award of the Nobel Prize in Chemistry last year for Emmanuelle Charpentier and Jennifer Doudna. This lecture will cover the discovery of the CRISPR system in bacteria and the steps leading to its development as a powerful genome editing technology, leading to new opportunities and challenges for humanity.

Malcolm White is a Professor of Biochemistry at the University of St Andrews. He has led a group there for 20 years, following periods of postdoctoral research in Scotland and California. He studies the CRISPR system in microbes, discovering new enzymes and pathways that provide antiviral immunity by detecting and destroying viral invaders. Malcolm is funded by the European Research Council and is an elected member of the European Molecular Biology Organisation.

Visits to Scientific Institutions

LIYSF is proud to introduce our students to the below eminent research centres, industrial sites and leading university departments. Our visits take place both in person and through virtual tours and digital materials, available on demand on our dedicated virtual platform. Scientific visits form an integral part of our programme for students to see science and engineering in action.

1. *Airbus UK*
2. *Alexander Fleming Laboratory Museum*
3. *Cardiff University - School of Pharmacy and Pharmaceutical Sciences & Cardiff University Brain Research Imaging Centre (CUBRIC)*
4. *Centre for Stem Cells & Regenerative Medicine, King's College London*
5. *Chelsea Physic Garden*
6. *Department of Chemical Engineering, Imperial College London*
7. *Health Services Laboratory*
8. *HR Wallingford*
9. *Imperial College Healthcare*
10. *John Innes Centre, Norwich Research Park*
11. *Linnean Society*
12. *London Wetland Centre*
13. *Old Operating Theatre and Herb Garret*
14. *Rolls Royce*
15. *School of Life Sciences*
16. *The National Space Academy*
17. *The Royal Institution*
18. *UK Atomic Energy Authority, Culham Science Centre*
19. *University College London, Mullard Space Science Laboratory*
20. *University of Cambridge, MRC Laboratory of Molecular Biology*
21. *University of Cambridge, Scott Polar Research Institute*
22. *University of Essex, Human Performance Unit*
23. *University of Oxford, History of Science Museum*
24. *University of Oxford, Pitt Rivers Museum*
25. *University of Oxford, Museum of Natural History*
26. *University of Oxford, Oxford Botanic Garden and Arboretum*
27. *University of Sussex*

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The Next Edition of LIYSF:

63rd London International Youth Science Forum

27th July – 10th August 2022

In memory of Tim Rooke, who supported LIYSF over a number of years, becoming a great friend and supporter of the Forum. We are truly very thankful for his contribution and miss him terribly. Tim was also the co-founder and trustee of the charity, Young Scientists for Africa (YoSA), which supports African students in attending LIYSF. This cause was incredibly close to Tim's heart and he loved the positive change the charity is making in providing opportunities for gifted African science students.

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The cover is dedicated to the scientific breakthroughs and applications in the COVID-19 pandemic. Science has been key in unlocking society and opening possibilities in moving forwards.

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