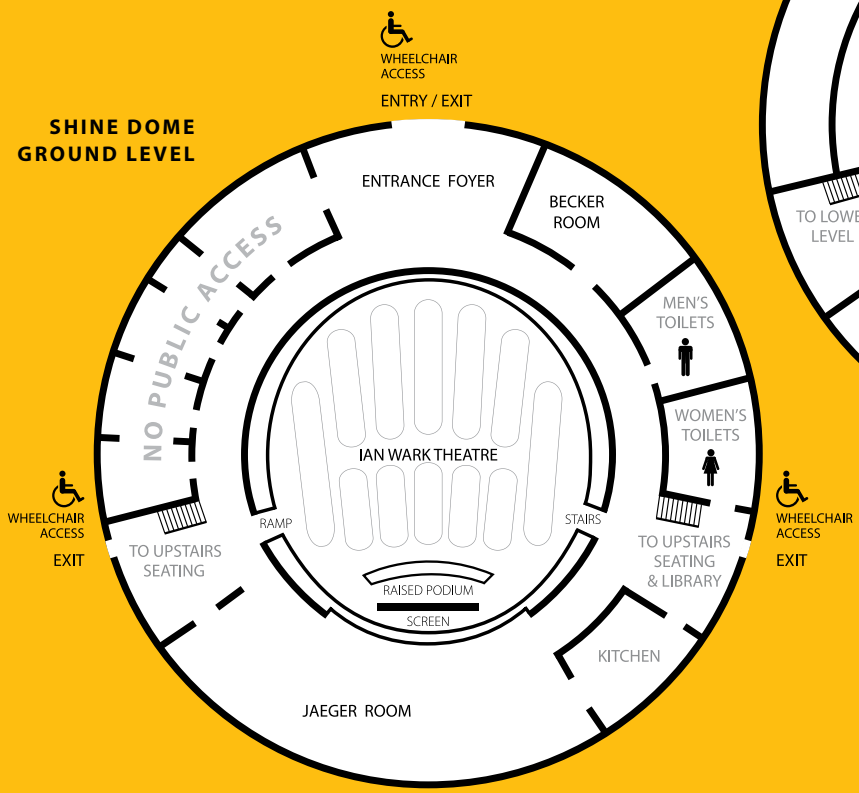
Australian Academy of Science

Science at the Shine Dome 2016

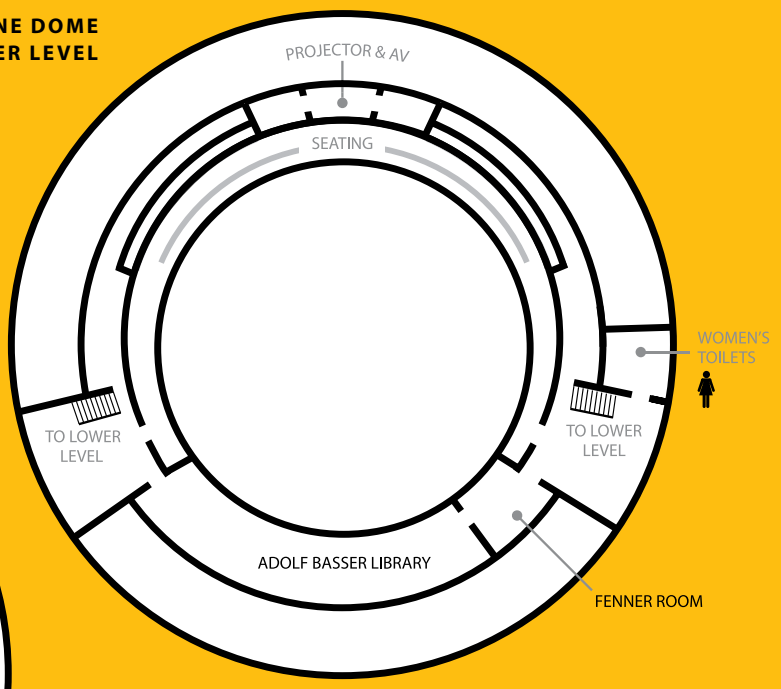
+ PROGRAM + 24–26 MAY

Human PLUS

SHINE DOME GROUND LEVEL



SHINE DOME UPPER LEVEL



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President's welcome


PHOTO: MARK GRAHAM

It is my great pleasure to welcome Fellows of the Australian Academy of Science, our generous sponsors, members of Parliament, special guests, early- and mid-career researchers, policy makers and other friends of science to our flagship annual event, Science at the Shine Dome.

At this year's event, we examine what it is to be human as, with the aid of bionics and other new-wave prosthetics, we become human PLUS. Prosthetics have come a long way. A far cry from early steel and wooden limbs, the enhanced human now boasts anything from integrated soft robotics to manufactured hearts, printed bones, and artificial limbs controlled by brain signals. Bionic hearing has already enhanced the lives of millions and bionic sight is in development around the globe. I am excited to hear about developments in the bionic spine, and am fascinated by the idea of printing human organs. Since the 1950s, the Academy has seized its annual meeting as an opportunity to hold a lens and a light to new, exciting and challenging areas of science. Our meeting this week carries on that tradition in very fine style.

I offer my warmest congratulations to the new Fellows who were elected this year. Election to the Fellowship is a singular recognition of your important contributions to advancing the sum of human knowledge. I look forward to welcoming you formally to the Fellowship and to hearing you present the highlights of your outstanding work.

I look forward also to the awards ceremony: each year the Academy recognises a small number of scientists for extraordinary lifetime achievements, and for highly significant attainments in early- to mid-career. I am sure the 2016 awardees will enlighten us with stimulating expositions of their research.

The Academy is committed to nurturing the careers of young scientists. I welcome the participation this week of early- and mid-career researchers from around Australia, 26 of whom have been supported to attend through the generosity of sponsors. You will find all our sponsors listed through the pages of this program, and on the back page. We are also delighted to host the small number of young scientists who have been selected through highly competitive processes to travel later this year to Germany, to participate in the annual meeting of Nobel Laureates in Lindau, as well as a small group of young Brazilian scientists who have been visiting Australian research facilities these past couple of months.

The Academy is keen to support and mentor promising early- and mid-career researchers, and to that end this week we are providing a range of opportunities for EMCRs to develop useful ancillary skills, and to form new friendships and initiate collaborative relationships that cross disciplinary, rank and geographic boundaries.

The grand finale of the week will be the Symposium organised under the guidance of Professor Srini Srinivasan. Human PLUS brings together an impressive program of speakers to explore the rapidly evolving ways in which we are using science and technology to enhance, support and augment the human body: to explore how human is becoming human PLUS.

I am so pleased you could join us for this 62nd annual general meeting of the Australian Academy of Science.

Professor Andrew Holmes AM PresAA FRS FTSE

Program Tuesday 24 May

• AWARD PRESENTATION • NEW FELLOW PRESENTATIONS

9.00 am	**Welcome** Professor Andrew Holmes AM PresAA FRS FTSE President, Australian Academy of Science
9.05 am	**2016 Macfarlane Burnet Medal and Lecture** Professor Graham Farquhar AO FAA FRS Australian National University *Using simple mathematics to explore the plant–atmosphere exchange of carbon dioxide, oxygen and water vapour*
Session one—New Fellow presentations	
Chairs	Professor Chennupati Jagadish AC FAA FTSE Dr TJ Higgins FAA FTSE
9.35 am	Dr Ian Allison AO FAA Antarctic Climate and Ecosystems CRC *Antarctic ice and snow in the global climate system*
	Professor David Bellwood FAA James Cook University *The past, present and future of coral reefs*
	Sir Philip Cohen FRS FAA (Corresponding Member) University of Dundee *Targeting protein kinases for the treatment of inflammatory and autoimmune diseases*
	Professor Benjamin Eggleton FAA FTSE University of Sydney *Photonic chips in the new information age: faster, smaller and smarter*
10.35 am	**Morning tea** **EMCR group photo** **EMCR awardees and Lindau participants group photos** **Please meet in foyer**
11.00am	Professor Geoffrey Fincher FAA FTSE University of Adelaide *Plant cell walls: from genomes to applications*
	Dr Alan Finkel AO FAA FTSE Office of the Chief Scientist *From electronics to synapse to powering the planet*
	Professor Maria Forsyth FAA (Elected 2015) Deakin University *Materials for advanced energy storage*
	Professor Matthais Hentze FAA (Corresponding Member) European Molecular Biology Laboratory *RNA-binding proteins, smart phones, and the sun*
	Dr John Kirkegaard FAA CSIRO Agriculture *From dust bowls to food bowls—Australia's conservation farming revolution*
	Professor Geoffrey Lindeman FAA Walter and Eliza Hall Institute for Medical Research *Understanding stem cells to get abreast of breast cancer*
12.30 pm	**Lunch** **New Fellow group and individual photos** **Please meet in foyer**
Session two—New Fellow presentations	
1.30 pm	Professor Alexander McBratney FAA University of Sydney *Digging*
	Professor Patrick McGorry AO FAA Orygen, The National Centre of Excellence in Youth Mental Health *Early intervention for mental illness in young people: concepts, evidence and translation*
	Professor Neville Nicholls FAA Monash University *El Niño: present, past, future*
	Professor Stephen Nutt FAA Walter and Eliza Hall Institute for Medical Research *The genetic control of immunity*
	Professor Halina Rubinsztein-Dunlop FAA University of Queensland *Optically driven nano and microsystems in classical and quantum realms*
	Professor Susan Scott FAA Australian National University *The first direct detection of gravitational waves*
3.00 pm	**Afternoon tea** **New Fellow individual photos continued** **Please meet in foyer**

Colour code New Fellows Fellows EMCRs/Lindau participants Awardees Symposium speakers

3.30 pm	**Dr Daniela Stock** FAA Victor Chang Cardiac Research Institute *Structure, function and dynamics of molecular machines* **Professor Fedor Sukochev** FAA UNSW Australia *Noncommutative analysis, geometry and probability* **Professor Toby Walsh** FAA UNSW Australia / Data61 *The dream of artificial intelligence* **Professor Naomi Wray** FAA University of Queensland *From livestock improvement to disorders of the brain via quantitative genetics*

4.30 pm	**Close** **Professor Andrew Holmes** AM PresAA FRS FTSE President, Australian Academy of Science
6.30 – 9.00 pm	**EMCR and Fellows BBQ reception** **Jaeger Room, Shine Dome** Participating early- and mid-career researchers are invited to a special BBQ reception at the Shine Dome. This is an informal opportunity to get to know one another, make connections and perhaps even meet a mentor; some Fellows of the Academy will attend.

Program Wednesday 25 May

• AWARDS PRESENTATIONS • EARLY- AND MID-CAREER RESEARCHER WORKSHOPS
• ANNUAL GENERAL MEETING • ANNUAL DINNER

9.00 am	**President's Address** Professor Andrew Holmes AM PresAA FRS FTSE
Career honorific award presentations	
9.30am	**2016 David Craig Medal** **Professor Jeffrey Reimers** FAA University of Technology Sydney/ Shanghai University *When chemistry becomes quantum: applying David Craig's principles to modern nanotechnology and biotechnology* **2016 Mawson Medal** **Professor Colin Vincent Murray-Wallace** University of Wollongong *From amino acids to changing sea levels and the movements of continents*

Early- and mid-career honorific award presentations	
10.00 am	**2016 Gustav Nossal Medal for Global Health** **Professor David Wilson** Burnet Institute *Achieving maximal health impact with available HIV resources* **2016 Jacques Miller Medal for Experimental Biomedicine** **Associate Professor Katherine Kedzierska** Peter Doherty Institute for Infection and Immunity *Immunity to pandemic and newly emerged influenza viruses*

Colour code New Fellows | Fellows | EMCRs/Lindau participants | Awardees | Symposium speakers

	2016 Nancy Millis Medal for Women in Science Dr Elena Belousova Macquarie University *Evolution of Earth's crust through the prism of zircon crystals*
10.30 am	**Morning tea** **Honorific awardees (early morning session) individual photos** **Please meet in Foyer**
11.10 am	**2015 John Booker Medal** Associate Professor Kylie Catchpole Australian National University *The bright future of solar energy* **2016 John Booker Medal** Dr Paolo Falcaro Graz University of Technology *Think small, tackle big problems* **2016 Fenner Medal** Associate Professor Jane Elith University of Melbourne *Species, distributions and models* **2016 Ruth Stephens Gani Medal** Associate Professor Geoffrey Faulkner Mater Research Institute, University of Queensland *Jumping genes in the human brain* **2016 Gottschalk Medal** Professor Ostoja Steve Vucic Westmead Clinical School, University of Sydney *Pathophysiology of amyotrophic lateral sclerosis: The role of cortical hyperexcitability*
12.00 pm	**Short stretch break**
12.10 pm	**2016 Anton Hales Medal** Professor John Paterson University of New England *The rise of animals over 500 million years ago: an Australian perspective* **2016 Christopher Heyde Medal** Dr Luke Bennetts University of Adelaide *Of ocean waves and sea ice*
	2016 Dorothy Hill Award Dr Andréa Taschetto UNSW Australia *Exploring the links between the tropical oceans and Australian climate* **2016 Pawsey Medal** Associate Professor Ilya Shadrivov Australian National University *Beyond natural materials* **2016 Frederick White Prize** Associate Professor Michael Ireland Australian National University *Zooming in on planetary birth and stellar death*
1.00 pm	**Lunch** **Awardees group and individual photos** **Please meet in foyer**
2.00 pm – 5.30 pm	**Early to mid-career researchers workshops** • Managing your time and staff Fenner Room/Library, level 1, Shine Dome • Broadening your vision: partnering with industry Becker Room, ground floor, Shine Dome • Creating good mentor–mentee relationships Board Room, level 1, Ian Potter House • How to pitch your research to the media Board Room, ground floor, Ian Potter House
2.30 pm – 5.00 pm	**Annual General Meeting** (Closed session for Fellows of the Academy)
6.45 pm	**Annual Black Tie Dinner** DRESS CODE: BLACK TIE/COCKTAIL PRE-DINNER DRINKS AT 6.45PM, DINNER AT 7.30PM QT Hotel, 1 London Circuit, Canberra **Presentation** **Macfarlane Burnet Medal** Professor Graham Farquhar AO FAA FRS **Dinner Address** Dr Alan Finkel AO FAA FTSE

Colour code New Fellows Fellows EMCRs/Lindau participants Awardees Symposium speakers

Program Thursday 26 May

ANNUAL SYMPOSIUM: HUMANPLUS

9.00 am	**Morning session one**
Chair	Professor Andrew Holmes AM PresAA FRS FTSE
9.00 am	**Welcome** Professor Andrew Holmes AM PresAA FRS FTSE
9.10 am	**Platinum sponsor welcome** Professor Joe Graffam Deakin University
9.15 am	**Keynote Address** *Minimally invasive neural interface* Dr Nicholas Opie University of Melbourne
10.15 am	*The challenge of restoring sight with vision prostheses* Professor Anthony Burkitt Bionic Vision Australia
10.45 am	**Morning tea**
11.15 am	**Morning session two**
Chair	Professor Jan Provis
11.15 am	*Bionic hearing, neurobionics and bioelectronics* Professor Rob Shepherd Bionics Institute
11.45 am	*Moving into a bionic world* Professor Michael Ibbotson National Vision Research Institute
12.15 pm	*3D printing in medicine* Professor Dietmar Hutmacher Queensland University of Technology
12.45 pm	**Lunch** **Symposium speakers group photo** **Please meet in foyer**

1.45 pm	**Afternoon session**
Chair	Dr Judith Reinhard
1.45 pm	*3D bioprinting: printing parts for bodies* Professor Gordon Wallace FAA FTSE Intelligent Polymer Research Institute, University of Wollongong
2.15 pm	*Bionic hearts and lungs—is it prime time yet?* Professor John Fraser Prince Charles Hospital
2.45 pm	**Afternoon tea**
3.15 pm	*Socio-ethical implications of the bionic era* Associate Professor Katina Michael University of Wollongong
3.45 pm	**Closing remarks** Professor Srini Srinivasan FAA
4.00 pm	**Coach to the airport**

Colour code New Fellows | Fellows | EMCRs/Lindau participants | Awardees | Symposium speakers

New Fellow presentations

Professor Ian Allison

AO FAA

Antarctic Climate and Ecosystems CRC

Professor Ian Allison is an Adjunct Professor at the University of Tasmania, a Research Associate of the Antarctic Climate and Ecosystems CRC, and a former program leader at the Australian Antarctic Division. He has studied ice and climate for nearly 50 years and participated in or led 25 research expeditions to the Antarctic. Professor Allison has published over 120 peer-reviewed science papers on topics including Antarctic weather and climate, ice shelf-ocean interaction, sea ice, and the mass budget of the Antarctic ice sheet. He has led international collaboration in Antarctic science for many years, including as co-Chair of the Joint Committee for the International Polar Year 2007–2008, a two-year research program involving more than 130 internationally collaborative science projects and 50,000 participants from 60 countries. He has been a lead author of the IPCC 2nd, 4th and 5th Assessment Reports, and President of the International Association of Cryospheric Sciences of the International Union of Geodesy and Geophysics.

Antarctic ice and snow in the global climate system

Antarctic ice is an integral component of the climate system. It provides clear indication of change and has profound influence on global weather and climate. Sophisticated space-borne monitoring systems have enabled assessment that Antarctica's contribution to sea level rise over the last two decades has been 0.24 mm yr–1. Professor Allison will explain how nearly 50% of the Antarctic coastline terminates in floating ice shelves where ice-ocean interaction includes complex processes of basal melt/freeze and water mass modification, as illustrated by data from an Australian project on the Amery Ice Shelf. Interaction between ocean and floating ice also provides a mechanism for collapse of parts of the ice sheet. Sea ice surrounding Antarctica is highly seasonal and unconstrained. Driven by strong winds, rapid ice drift affects both sea ice extent and thickness. Sea ice influences energy exchange between the ocean and atmosphere, and brine discharge from growing sea ice modifies the ocean structure and controls overturning circulation.

Professor David Bellwood FAA

James Cook University

Professor David Bellwood is a leading researcher in the field of coral reef evolution and ecology. His exceptional body of work spans multiple disciplines including palaeontology, molecular biology, ecosystem function, biogeography and social-ecological systems. His findings have advanced our understanding of how coral reefs evolved, their global biogeography and their capacity to withstand human impacts. His work focuses on ecosystem function, examining the roles that organisms play in maintaining high-diversity ecosystems.

The past, present and future of coral reefs

Coral reefs are one of the world's most iconic high-diversity ecosystems. They are also one of the most vulnerable. Using an ecosystem function approach, Professor Bellword will describe how our knowledge of organismal design has enabled us to explore the evolutionary history of coral reefs from the Jurassic to present; how it provides unique insights into the functioning of high-diversity systems at a global scale; and how the recognition of critical ecosystem functions can help us to respond to the challenges of human impacts on coral reefs today and in the future.

Sir Philip Cohen FRS FAA

(Corresponding Member)

University of Dundee

Professor Sir Philip Cohen trained at the University College, London and then spent two years at the University of Washington, Seattle, USA before joining the School of Life Sciences at the University of Dundee, Scotland in 1971, where he has worked ever since. He has been a Royal Society Research Professor (1984–2010), Director of the MRC Protein Phosphorylation Unit (1990–2012) and Director of the Scottish Institute for Cell Signalling (2008–2012). Sir Philip is best known for pioneering the field of protein phosphorylation, a biological control mechanism that regulates most aspects of cell life. He discovered enzymes that have been targeted by pharmaceutical companies to develop improved drugs for the treatment of cancer and arthritis, and worked out how insulin converts glucose to glycogen. His current research is focused on innate immune signalling networks. Professor Cohen has received many prestigious awards and medals, and was knighted for services to biochemistry. He was made a Corresponding Member of the Australian Academy of Science in 2014.

Targeting protein kinases for the treatment of inflammatory and autoimmune diseases

The production of inflammatory mediators by the innate immune system is critical for defense against microbial pathogens, but the overproduction of these substances, or failure to terminate the inflammatory process once it has done its job, is the cause of many diseases. Protein kinases are involved in controlling inflammatory mediator production but their validation as targets for the development of anti-inflammatory drugs requires a detailed molecular understanding of how they regulate innate immune signaling networks. Professor Cohen will discuss four different aspects of recent research in his lab that are relevant to this topic. First, unexpected findings that show the 'textbook' accounts of the MyD88-dependent signaling network require significant revision. Second, the identification of mechanisms that restrict the activation of the MyD88 signalling network to prevent autoimmunity. Third, the discovery of a subfamily of protein kinases that restrict the conversion of inflammatory macrophages to the anti-inflammatory macrophages thought to be critical for the resolution of inflammation. Fourth, the surprising finding that an anti-inflammatory drug, thought to be a protein kinase inhibitor, actually exerts its beneficial effects by targeting components of the ubiquitin system.

Professor Benjamin Eggleton FAA FTSE

University of Sydney

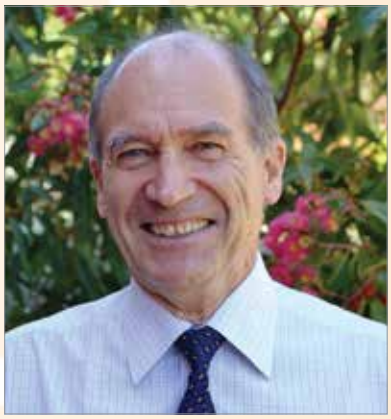
Professor Benjamin Eggleton is an ARC Laureate Fellow and Professor of Physics at the University of Sydney and is the founding Director of the ARC Centre of Excellence for Ultrahigh bandwidth Devices for Optical Systems (CUDOS). He obtained his PhD degree in physics from the University of Sydney in 1996. He then joined Bell Laboratories, Lucent Technologies, and became Research Director within the Specialty Fiber Business Division of Bell Laboratories, where he was engaged in forward-looking research supporting Lucent Technologies business in optical fibre devices. He is co-author of more than 420 journal publications and over 200 invited presentations with 15,000 citations and an h-index of 60, and has filed about 35 patents. Professor Eggleton is a Fellow of the Optical Society of America, IEEE Photonics and the Australian Academy of Technological Sciences and Engineering (ATSE).

Photonic chips in the new information age: faster, smaller and smarter

Professor Eggleton's research aims to bring about a revolutionary development combining the distinct capabilities of light, sound and electronics in nanoscale circuits. Functions in health, security and communications that were previously impossible, or required devices the size and weight of a large personal computer, will be accomplished on centimetre scale chips, using a fraction of the electrical power, compatible with use in smartphones. By controlling and coupling light, sound, and electronics at the nanoscale, his research is transforming integrated circuits from mere information processors to devices that actively respond to and influence their environment. With his team, Professor Eggleton is harnessing cutting-edge advances in nonlinear physics, world-class nanofabrication facilities and advanced materials to produce nationally significant outcomes, from mobile health diagnostics and drug delivery to major improvements in radar and microwave communications.

Professor Geoffrey Fincher FAA FTSE

University of Adelaide



Geoff Fincher received his PhD from the Department of Biochemistry at the University of Melbourne. Recently he has been Director of the ARC Centre of Excellence in Plant Cell Walls (2011–14), Cluster Leader of the CSIRO Food Futures Flagship on High Fibre Grains (2011–13), Deputy CEO of the Australian Centre for Plant Functional Genomics (2003–10) and Director of the Waite Campus of the University of Adelaide (2003–10). Professor Fincher's research interests are focused on the molecular genetics and biochemistry of cell wall polysaccharide biology in cereals and grasses. In 2013 Geoff was awarded the Thomas Burr Osborne Medal; the premier award of the American Association of Cereal Chemists International. He is a Corresponding Member of the American Society of Plant Biology and a Fellow of the Australian Academy of Technology and Engineering.

Plant cell walls: from genomes to applications

Plant cell walls are dynamic structures that are important for the physical strength of all land plants. Their functional requirements are met through the formation of a reinforced gel, in which microfibrils of cellulose represent the reinforcing rods and a highly variable array of non-cellulosic polysaccharides, together with lignin and smaller amounts of protein, represent the matric phase of the reinforced gel. Professor Fincher will explain how, with an estimated annual production of cellulose from captured solar energy of about 180 billion tonnes, crop and plant residues represent a massive reserve of fermentable sugars that can be released for the production of renewable liquid biofuels. In addition, the non-cellulosic polysaccharides from cell walls in food plants are an important source of dietary fibre in humans, where they are known to reduce the risk of several serious diseases.

Dr Alan Finkel AO FAA FTSE

Office of the Chief Scientist

Dr Finkel is Australia's Chief Scientist and has an extensive science background as an entrepreneur, engineer, neuroscientist and educator. Prior to becoming Chief Scientist, he was the Chancellor of Monash University and President of the Australian Academy of Technology and Engineering (ATSE).

Dr Finkel was awarded his PhD in electrical engineering from Monash University and worked as a postdoctoral research fellow in neuroscience at the Australian National University. He then founded a company in the US that made precision scientific instruments for the discovery of new medicines.

Following his return to Australia in 2006, he led the formation of the Florey Neuroscience Institutes; became Chair of the Australian Centre of Excellence for All-Sky Astrophysics (CAASTRO); and was involved in diagnostics, education, investment, technology and construction businesses. Committed to science education, Dr Finkel co-founded Cosmos Magazine, which in addition to magazine publishing operates a secondary schools science education program. At ATSE, he led the development and implementation of the STELR program for secondary school science, which has been adopted in nearly 500 Australian schools. Dr Finkel also established the Australian Course in Advanced Neuroscience to train early career neuroscientists.

From electronics to synapse to powering the planet

A personal journey from designing transistors to advocating for policy.

Professor Maria Forsyth FAA

(Elected 2015)

Deakin University

Professor Maria Forsyth is an Australian Laureate Fellow and an Alfred Deakin Professorial Fellow at Deakin University. She is the Associate Director in the ARC Centre of Excellence in Electromaterials Science and Deputy Director of the Institute for Frontier Materials at Deakin University, where she leads the research effort in energy storage and corrosion science. Her work has focused on understanding the phenomenon of charge transport at metal/electrolyte interfaces and within novel electrolyte materials. Such materials have included a range of novel ionic liquids, polymer electrolytes and plastic crystals. Nuclear magnetic resonance (NMR) techniques have featured strongly in Professor Forsyth's research where she has applied pulsed field gradient NMR to measure diffusion of ionic species in electrolytes, variable temperature solid state wide line NMR and magic angle spinning (MAS) to investigate structure and dynamics in solids and, most recently, NMR imaging of electrochemical processes. She leads collaborative projects in lithium and sodium battery technologies funded through recent Australian Research Council grants. Professor Forsyth is a co-author of over 400 journal and conference publications attracted more then 11,000 citations. She has delivered more than 25 invited and plenary talks in the past five years.

Materials for Advanced Energy Storage

Renewable energy—including solar, wind and wave sources—are available today at competitive prices. However, our ability to use these 24/7 relies on our ability to store energy when the sun doesn't shine and the wind doesn't blow. Battery technologies already have revolutionised our lives through our use of portable electronics. It's now time to further develop these to revolutionise the way we use renewables. Professor Forsyth will explain how her ongoing energy materials research continues to look for new electrolytes with high conductivity and improved safety and reliability, and how advanced characterisation and molecular modeling have contributed to the understanding and continued optimisation of next generation electrolytes including polymer electrolytes, ionic liquids and plastic crystals.

Professor Matthais Hentze FAA

(Corresponding Member)

European Molecular Biology Laboratory

Professor Matthias Hentze is a world-leading biomedical researcher and early pioneer of RNA research. His contributions to translational control, including IRE regulation of ferritin mRNAs, are now in all leading textbooks of biochemistry and molecular cell biology. His recent work, in collaboration with Australian scientists, has led to the discovery of hundreds of new RNA-binding proteins involved in gene regulation. These discoveries foreshadow a new phase in our understanding of genome functions and metabolism, with numerous biological processes affected by genomically transcribed RNAs that control the functions of existing proteins. In 2013, Professor Hentze was appointed Director of the European Molecular Biology Laboratory (EMBL), one of the premier biology research centres in the world and an official strategic partner of Australian science. Australia was the first EMBL Associate Member state and the laboratories provide important training opportunities for Australian scientists. Hentze has received numerous prestigious research awards, including Germany's highest research honour, the Gottfried Wilhelm Leibniz Prize (2000), and the Feodor Lynen Medal and Lecture (2015).

RNA-binding proteins, smart phones, and the sun

Intuitively, most of us consider the nucleus as the cellular site at which gene regulation occurs. Although this is correct, it is not the whole truth. It took nearly the past three decades before we could appreciate the full importance of genetic control in the cytoplasm, based on RNA rather than DNA. Professor Hentze will discuss the discovery and importance of this long overlooked 'solar system'. New results suggest a surprising possibility of how RNA-based gene regulation ('nature') and environmental stimuli and metabolism ('nurture') could communicate with each other using a class of proteins that his team discovered (so called enigmRBPs) as 'smart phones'.

Dr John Kirkegaard FAA

CSIRO Agriculture

Dr John Kirkegaard is a Chief Research Scientist at CSIRO Agriculture, based in Canberra, and Adjunct Professor at the School of Plant Biology, University of Western Australia and Charles Sturt University. He received his PhD from the University of Queensland in 1990 and his research has focused on understanding soil–plant interactions to improve the productivity, resource-use efficiency and sustainability of dryland farming systems. He has led numerous national research programs, is a regular invitee to international forums and advisory committees on agriculture and food security and was Visiting Professor at Crop Science Department, University of Copenhagen in 2012. A hallmark of his innovative research has been its rapid adoption and impact in agriculture. He was recipient of the grains industry 'Seed of Light' award in 2008, CSIRO Medal for impact from science in 2013, and in 2014 his team was awarded the Eureka Prize in sustainable agriculture for research to improve the water-use efficiency of Australian agriculture.

From dust bowls to food bowls—Australia's conservation farming revolution

The global food security challenge is felt keenly in Australia, where agriculture operates on fragile soils in a variable and changing climate. Ironically, in a land plagued by drought, water is often used inefficiently by crops. Professor Kirkegaard will describe how his team has focused on the improved capture, storage and efficient use of rainfall by plants in conservation cropping systems. The research ranges in scale from studies that identified and overcame deleterious microbes at the root-soil interface and improved the capture of water by root systems in the subsoil, to those designing better crop sequences. He will explain ways to capture synergies between novel crop management strategies and new varieties to further increase productivity. Underpinned by this fundamental and adaptive agricultural research, Australia's innovative farmers

now lead the world in the adoption of conservation agriculture to improve production while protecting the soil and environment.

Professor Geoffrey Lindeman FAA

Walter and Eliza Hall Institute for Medical Research

Professor Geoff Lindeman, a clinician-scientist, is Joint Head of the Stem Cells and Cancer Division at the Walter and Eliza Hall Institute of Medical Research. He is also a medical oncologist and Director of the Joint Familial Cancer Centre at The Royal Melbourne Hospital and Peter MacCallum Cancer Centre, and honorary Professorial Fellow in the Department of Medicine, University of Melbourne. Professor Lindeman and his team identified the stem and daughter 'progenitor' cells that generate all ductal tissue in the breast, in both mice and humans. His group was the first to identify the culprit progenitor cell responsible for breast cancer in BRCA1 mutation carriers. These discoveries have provided a new framework for studying the molecular and cellular events that lead to breast cancer, with direct implications for treatment and prevention of the disease. He has translated his group's fundamental research findings into novel early phase clinical trials.

Understanding stem cells to get abreast of breast cancer

The mammary gland develops in distinct stages including puberty, pregnancy, lactation and regression (post-weaning), largely orchestrated by female hormones. Professor Lindeman's group is interested in determining how stem and daughter 'progenitor' cells contribute to maturation and homeostasis (maintenance of the 'steady state'), with the goal of elucidating key molecular and cellular events that go awry and lead to breast cancer. Professor Lindeman will describe how his group identified stem and progenitor cells and the cellular hierarchy that contributes to the formation of ductal tissue in the breast. 'Lineage tracing' studies confirmed that stem cells can produce the two main cell types in breast ducts, and long-lived progenitors that sustain the mammary tree. He will explain how the crucial role of female steroid hormones was explored, revealing how hormone 'sensor' cells switch on stem and progenitor cells. He will also look at the discovery of aberrant progenitor cells in breast cancer prone BRCA1 mutation carriers, implicating them as the culprits that instigate cancer and revealing a novel breast cancer prevention strategy.

Professor Alexander McBratney FAA

University of Sydney

Professor Alex McBratney has made major contributions to soil science through the development of the concepts of pedometrics, digital soil mapping and precision agriculture. After completing his PhD work at Rothamsted Experimental Station in the UK, he spent seven years with CSIRO Division of Soils in Brisbane. He joined the University of Sydney in 1989 to lead the soil science discipline. Professor McBratney is Dean of the Faculty of Agriculture and Environment and Professor of Soil Science, and Chief Editor of the global soil science journal, Geoderma. He is heavily involved with the activities of the International Union of Soil Sciences and the global digital soil map project, GlobalSoilMap. In 2014 he was awarded the VV Dokuchaev medal by the International Union of Soil Sciences, which is the highest honour in the soil science discipline. He is currently helping to develop and promote the concept of global soil security.

Digging

Unlike Seamus Heaney in his famous poem, Professor McBratney has been allowed to use the spade all his working life. Digging is his metaphor for the study of the science of soil. He will describe some key locations in a 40-year digging tour, a journey from a short transect in rural Aberdeenshire to the whole world. It is also a brief report from a small discipline with a huge task: that of understanding, and providing evidence-based management advice for, the world's soil. In this digging journey Professor McBratney will describe basic notions of pedometrics and digital soil mapping and more, applied real time to precision agriculture and radical soil management. All of this can be integrated under the multi-disciplinary concept of soil security. This has been a sustained, peripatetic, fertile and pedodiverse excursion. He still dreams of the digital spade.

Professor Patrick McGorry AO FAA

Orygen, The National Centre of Excellence in Youth Mental Health

Professor McGorry is an Irish-born Australian psychiatrist known world-wide for his development of early intervention strategies for young people with mental illness. He is executive director of Orygen, the National Centre of Excellence in Youth Mental Health; Professor of Youth Mental Health at the University of Melbourne; and founding editor of Early Intervention in Psychiatry. He led the advocacy, design and implementation of the National Youth Mental Health Foundation, headspace. He has published over 500 peer-reviewed articles, and has edited six books. Over the past decade he has raised over $150 million for mental health research, and has played a key advocacy and advisory role to government and health system reform in many parts of the world. President of the Society for Mental Health Research in Australia, and of the Schizophrenia International Research Society, Professor McGorry was selected in 2010 as Australian of the Year. In 2013 he received the Annual Research Award from the National Alliance for the Mentally Ill in Washington DC, and in 2015 was awarded the Lieber Prize for Schizophrenia Research by the US-based Brain and Behaviour Foundation.

Early intervention for mental illness in young people: concepts, evidence and translation

One of the greatest opportunities in Australian public health is to reduce the mortality and morbidity caused by mental illness. In contrast to cancer and cardiovascular disease, despite increased public awareness, there have been no improvements in death or disability rates from mental illness in recent decades. Indeed, suicide has increased sharply and mental illness is the largest and fasting growing source of disability. With mental illness projected to have the greatest impact on global economic output of all the non-communicable diseases (NCDs), there is an economic imperative to replicate what has been accomplished in other disease areas. Prevention, early diagnosis and sustained access to evidence-based treatment have underpinned health gains in the other major NCDs, and these areas have been the focus of Professor McGorry's research career over the past 30 years. Professor McGorry will explain how the development, evaluation and translation of novel therapies and new cultures of integrated care for young people in the early stages of mental ill health have been the products of his research, which has also explored the neurobiology of onset. He will also describe how he has put a major emphasis on evidence-generating reform, and new investment in preventive mental health care nationally and internationally.

Professor Neville Nicholls FAA

Monash University

Professor Neville Nicholls is a leading expert in the nature, causes, predictability and impacts of interannual climate variability in Australia and its region. His research is the basis for operational prediction of climate variations and their impacts including droughts, crop yields, bushfire and tropical cyclone activity, and human health impacts, in Australia and elsewhere. He initiated and led the development of high-quality historical climate databases for Australia and their use in understanding the causes of climate variations and change, and led national and international assessments of observed changes in climate, focused on climate and weather extremes.

El Niño: present, past, future

The El Niño – Southern Oscillation (ENSO) is a natural fluctuation of the climate system that is associated with serious disruptions to the climate in many locations around the Indian and Pacific oceans. The two extremes of ENSO, labelled El Niño and La Niña events, typically start around May and end around May of the following year. Only rarely do these events, once they have started, 'abort' between June and the end of the calendar year. Professor Nicholls will explain how this characteristic lifecycle allows us to make useful seasonal climate predictions. He will ask how might this situation change as the world continues to warm in future decades? Is global warming already changing how ENSO impacts the climate?

Professor Stephen Nutt FAA

Walter and Eliza Hall Institute for Medical Research

Professor Stephen Nutt has devoted his scientific career to investigating the cell fate determination process and particularly how a select group of transcription factors act as the master regulators of haemopoietic lineage commitment and cellular differentiation. Professor Nutt has made some of the most important findings in this field, including defining the roles of Pax5 and Blimp1 in B cell and plasma cell commitment, respectively. These studies have made a major impact on both our theoretical understanding of cellular decision-making processes

and in deciphering what goes awry in diseases such as leukaemia and autoimmunity.

The genetic control of immunity

The immune system needs to balance the need to robustly and effectively respond to microbial challenge while at the same time ignore our own tissues and the many commensal bacteria that reside in our bodies. Professor Nutt will describe his research, which focuses on the question of how cell fate and differentiation decisions are controlled in the immune system to achieve this balance. The differentiation of B cells into either memory B cells or antibody-secreting plasma cells is one such cell fate decision that Professor Nutt and his team have shown is controlled by the interaction of a handful of transcription factors with extrinsic signals, including antigen and cytokine. They have defined a molecular signature that highlights the stark transcriptional divide between B cells and plasma cells, as well as examined how plasma cells reprogram their transcriptome and physiology to although the sustained expression of the extremely large amounts of antibody that provides protective immunity.

Professor Halina Rubinsztein-Dunlop FAA

University of Queensland

Professor Halina Rubinsztein-Dunlop is a Director of the Quantum Science Laboratory in the School of Mathematics and Physics at the University of Queensland. She obtained her PhD degree at the University of Gothenburg, Sweden. Halina leads two research groups at the University of Queensland and runs a program in the Australian Research Council Centre of Excellence in Engineered Quantum Systems. Her research interests are in quantum atom optics, laser micromanipulation, laser physics, linear and nonlinear high resolution spectroscopy, and biophtonics. She has over 240 publications in international peer refereed journals, 11 book chapters and a large number of international conference contributions and several invited, keynote and plenary talks. Professor Rubinsztein-Dunplop's group in laser micromanipulation/optical tweezers was the first to demonstrate the transfer of angular momentum of light to microscopic particles. The work has led to a number of interesting and innovative applications in the area of optically driven microsystems with further application into biological and biomedical systems.

Optically driven nano and microsystems in classical and quantum realms

The aim to build and apply optically driven mechanical systems at ever smaller scale runs into many problems. The use of the linear momentum and orbital and spin angular momentum solves many of these difficulties and provides means to drive such systems. Professor Rubinsztein-Dunlop will describe the significant progress made by a number of groups in optically driven micromachines. The ultimate scale to which one can take such systems according to classical mechanics depends on Brownian motion and fabrication. At increasingly smaller scale the quantum effects become more important. However these effects are not obstacles but rather represent resources to be exploited in order to provide a way to the development of novel quantum technologies. The ultimate case is a Bose-Einstein Condensate that can be created and manipulated.

Professor Susan Scott

FAA

Australian National University

Professor Susan Scott is Professor of Theoretical Physics at ANU. Her research field is gravitational physics, including general relativity, cosmology and gravitational waves; she is an international expert on space–time singularities and black holes. She has a BSc (Hons) from Monash University, a PhD from The University of Adelaide, and spent four years on a Rhodes Fellowship at the University of Oxford working with the research group led by Professor Sir Roger Penrose. In 1998 Professor Scott joined the Laser Interferometer Gravitational-wave Observatory (LIGO) Scientific Collaboration and initiated and led the Australian effort in the analysis of data from the two LIGO gravitational wave detectors. She has co-authored a definitive book on rotating black holes, as well as more than 200 research papers in the field of gravitational physics, and is a Fellow of the Institute of Physics (UK), the Australian Institute of Physics and the European Academy of Sciences.

The first direct detection of gravitational waves

Professor Scott will give an overview of the recent discovery event by the Laser Interferometer Gravitational-wave Observatory (LIGO) of the first direct detection of gravitational waves. She will discuss the history of the project, gravitational waves, the LIGO detectors,

the binary black hole coalescence event which we observed, and Australian involvement in this discovery.

Dr Daniela Stock FAA

Victor Chang Cardiac Research Institute

Dr Daniela Stock was trained in mineralogy and crystallography at the University of Heidelberg and the Free University of Berlin, Germany, where she graduated in 1992. She completed her PhD in protein crystallography at the Max-Planck Institute of Biochemistry in Munich in 1996 (Kekulé Fellowship with Robert Huber working on 20S proteasomes), followed by post-doctoral work at the MRC Laboratory of Molecular Biology in Cambridge, UK (EMBO long-term Fellowship with John Walker working on ATP synthases). In 2000 she became an independent Group Leader at the MRC Laboratory of Molecular Biology (MRC Career Development Award working on structures of molecular machines). She joined the Victor Chang Cardiac Research Institute in 2006, where she heads the Structural Biology Laboratory funded by ARC, NHMRC and an NHMRC Senior Research Fellowship. Her research focuses on the structure and function of membrane protein complexes and molecular machines, in particular rotary ATPases and the bacterial flagellar motor.

Structure, function and dynamics of molecular machines

How does life work at the molecular level? Every living cell consists of molecular machines that have evolved over billions of years to a level of sophistication that is far beyond anything man can build. Made from self-assembling protein complexes, they convert chemical energy into motion with efficiencies approaching 100%, while being completely renewable. Using X-ray crystallography and electron cryo-microscopy, Dr Stock's lab has been studying molecular machines involved in biological energy conversion, in bacterial locomotion and in protein folding. She will present a few highlights of her lab's findings showing that molecular machines have much in common with basic design principles of man made machines—from the function of individual 'machine elements' to the requirement of the right 'fuel' and 'oil' for different types of motors. Their study is important, not only to further medical research, but also to understand the origins of life, ageing and to take a lesson in engineering.

Professor Fedor Sukochev FAA

UNSW Australia

Professor Fedor Sukochev is a professor of Mathematics at UNSW Australia. He received his Master and PhD degrees from Tashkent State University (Uzbekistan). In the period 1994–2008 he worked at Flinders University of South Australia and moved to Sydney upon taking a position of Chair in Pure Mathematics. His research focuses on noncommutative analysis, geometry and probability. In 2012–15 he was awarded with an ARC Discovery Outstanding Researcher award.

Noncommutative analysis, geometry and probability

The advance of noncommutative geometry and analysis was prompted by the needs of modern quantum physics. Noncommutative analysis is the analysis of quantities where the order of observation changes the outcome. Noncommutative geometry is the study of 'spaces' where the order of observation of coordinates is important. Noncommutative (or quantum) probability theory deals with random processes of importance in quantum physics. Professor Sukochev will explain his research on all of these topics, and their inter-relations.

Professor Toby Walsh

FAA

UNSW Australia / Data61

Professor Toby Walsh is a leading researcher in artificial intelligence (AI). He was recently named in the inaugural Knowledge Nation 100, the one hundred 'rock stars' of Australia's digital revolution. He is a Professor of Artificial Intelligence at the University of New South Wales and leads a research group at Data61, Australia's Centre of Excellence for ICT Research. He has been elected a Fellow of the Association for the Advancement of AI for his contributions to AI research, and has won the prestigious Humboldt research award. He has previously held research positions in England, Scotland, France, Germany, Italy, Ireland and Sweden.

The dream of artificial intelligence

For hundreds of years, humankind has dreamed of building machines that might think. Professor Walsh has spent his research career working to this goal. He will explore how far along are we with this bold enterprise, and how it will it change our lives.

Professor Naomi Wray

FAA

University of Queensland

Professor Naomi Wray is co-director of the Centre for Neurogenetics and Statistical Genomics at the Queensland Brain Institute of the University of Queensland. She is an NHMRC Principal Research Fellow. She is a quantitative geneticist who has contributed to advances in quantitative genetic theory, with applications in agriculture and medicine. Her work on the prediction of rates of inbreeding in populations undergoing selection led to changes in agricultural selection programs worldwide in balancing genetic improvement with levels of inbreeding. More recently, she has developed quantitative genetic methods for the estimation of genetic parameters from genetic epidemiology studies and methods for genetic risk prediction. She is particularly recognised for application of these to psychiatric disorders, which is contributing to the elucidation of the genetic basis of common, distressing, complex disorders. Currently, she leads programs in the systems genomics of sporadic ALS motor neuron disease and autism spectrum disorders.

From livestock improvement to disorders of the brain via quantitative genetics

Professor Wray will describe how traits of economic importance in livestock and common diseases/disorders in humans are complex genetic traits, which means variation between individuals reflects many genetic and non-genetic factors. Livestock improvement results from identification of genetically superior individuals to be the parents of the next generation. Even if close relatives are avoided, selected parents will be genetically more similar to each other than a randomly selected group of individuals. Professor Wray will explain how novel quantitative genetic theory showed how to plan optimal breeding schemes in the livestock industry to maximise genetic gain while accounting for reduction in variation as a consequence of selection. In human common diseases with a highly polygenic architecture, affected individuals are genetically more similar to each other than a randomly selected group of individuals, allowing parallels in quantitative genetic theory of disease and of livestock improvement. These parallels have allowed insights into the complexity of human disease with particular application to disorders of the brain.

Absent new Fellows

Also elected this year, but unable to join us for the new Fellow presentations, are:

- **Professor Simon Foote** FAA
  The Australian National University
- **Professor Justin Gooding** FAA
  The University of New South Wales
- **Dr Anna Koltunow** FAA
  CSIRO Agriculture
- **Professor Sarah Robertson** FAA
  Robinson Research Institute

2016 Macfarlane Burnet Medal and Lecture

FOR SCIENTIFIC RESEARCH OF THE HIGHEST STANDING IN THE BIOLOGICAL SCIENCES

The Macfarlane Burnet Medal and Lecture recognises scientific research of the highest standing in the biological sciences. It commemorates the contributions to science by Sir Macfarlane Burnet OM KBE MD FAA FRS Nobel Laureate.

Professor Graham Farquhar AO FAA FRS

Australian National University

Professor Graham Farquhar is an outstanding plant scientist whose innovative work has had a far-reaching impact on our understanding of plant function in a changing world. Combining mathematical rigour and biological insight, his highly cited research has been applied at vastly different scales, from how plants partition their resources between water use and photosynthesis to global interactions between vegetation and the atmosphere. His work has enabled development of crop varieties that are better equipped to cope with changing environmental conditions, particularly those associated with drought. In 2015, Professor Farquhar was awarded the Prime Minister's Prize for Science.

Using simple mathematics to explore the plant–atmosphere exchange of carbon dioxide, oxygen and water vapour

Plants are brilliant organisms with exquisite sensing of their environment, and remarkable coordination in their responses. Simple mathematical treatments based on physical, chemical or economic models give order to our observations of plant behaviour, allow us to make predictions, and speed up human communication about the effects of environmental or genetic perturbations. Professor Farquhar will discuss stochastic rainfall, optimal water use, and how to recognise differences across genotypes using measurements of carbon isotope discrimination, and organic oxygen isotope composition. The context is plant growth in a changing climate: predicted and observed multi-decadal changes in carbon dioxide concentration, precipitation and crop demand for water.

Academy Awards 2016

CAREER HONORIFIC AWARDS

David Craig Medal

Professor Jeffrey Reimers FAA

University of Technology Sydney
Shanghai University

Professor Jeffrey Reimers studied organic spectroscopy under Ian Ross and Gad Fischer before doing a PhD with Bob Watts on the structure, thermodynamics, and spectroscopy of water and ice. He then studied semiclassical quantum mechanics in the United States under Kent Wilson and Rick Heller before returning to Australia to be an ARC Research Fellow from 1985 to 2010 at the University of Sydney. There he collaborated extensively with Noel Hush and Max Crossley on problems involving electron transfer, molecular electronics, porphyrin chemistry, electronic-structure theory, and photosynthesis. In 2014 he moved to a joint appointment at the University of Technology and Shanghai University, focusing on new methods for protein crystallography. His work spans a wide range of chemical applications, from mutagenesis to electrical engineering to the origins of consciousness. He has received the Royal Australian Chemical Institute (RACI) Physical Chemistry Division Medal and the HG Smith Medal, and is a Fellow of the RACI and the Australian Academy of Science.

When chemistry becomes quantum: applying David Craig's principles to modern nanotechnology and biotechnology

Usually chemistry is described in terms of motions of atomic nuclei moving in accordance with Newton's laws of motion. However, to obtain the forces acting on the nuclei driving chemical processes, one must solve the quantum mechanical equations for the motions of the electrons within molecules. David Craig pioneered theories for going beyond this description, allowing electrons and nuclei to be treated on an equal footing, typically focusing his work on understanding molecular spectroscopy. In modern times, much of science and technology is being driven by the search for materials that are unusual, and often this involves exploiting Craig's ideas. The work of Jeffrey Reimers and his team provides basic understanding for unusual processes, describing, for example, critical aspects of natural photosynthetic function (with relevance to organic solar cells and artificial photosynthesis), how gold nanoparticles form (relevant to modern plasmonics, catalysis, and medical applications), and how single molecules can be used as semiconductors in electronic devices.

Mawson Medal

Professor Colin Murray-Wallace

University of Wollongong

Professor Colin Murray-Wallace completed his PhD and DSc degrees in geology at the University of Adelaide. His research has focused on the Quaternary stratigraphy and evolution of marginal marine environments in response to climate and sea-level changes, and neotectonism, both in Australia and abroad. He has spearheaded the development of amino acid racemization as a technique for dating sedimentary successions beyond the range of many Quaternary dating methods. His research has unravelled the complex record of Quaternary sea-level changes in Australia and highlighted the importance of these records in defining global sea-level trends. His recent research has enabled the dating of microfossils such as single foraminifers, opening a new level of understanding about the complexity of taphonomic processes in sedimentary environments. His coastal research in southern Australia has revealed evidence for neotectonism during the Quaternary in a continent traditionally regarded as tectonically highly stable.

From amino acids to changing sea levels and the movements of continents

Professor Murray-Wallace will examine the geological application of amino acids (amino acid racemisation—AAR) in determining the age of geological successions younger than 2.5 million years. He will use several case studies to show how the AAR method has been used in documenting rates of relative sea-level changes, long-term patterns of coastal evolution, and vertical crustal movements of parts of the Australian continent.

EARLY- AND MID-CAREER HONORIFIC AWARDS

Nancy Millis Medal

Dr Elena Belousova

Macquarie University

Dr Elena Belousova uses accessory minerals to fingerprint the geochemical and geodynamic evolution of the Earth's crust. Her research provides new insights into the processes of continental crust generation and its genetic relationship with the deeper mantle over 4.5 billion years of evolution. She also contributed significantly to the success of the TerraneChron® tool, which now has wide global uptake in fundamental research and in the mineral exploration industry.

Evolution of Earth's crust through the prism of zircon crystals

The continental crust represents only 0.4 wt% of Earth's total volume and covers only 41% of its surface. Despite this volumetric insignificance, the continental crust is essential to human life, and an understanding of its evolution is critical to the exploitation of its mineral and energy resources. The continental crust also records a long history of differentiation and modification, which is a key to understanding the evolution of Earth as a planet. Dr Belousova's research uses mineral zircon, a tiny time capsule, to investigate the evolution of the continental crust. This approach simultaneously provides data on the age, composition and, most importantly, the sources of magmas, allowing distinction between magmas derived from the mantle or recently extracted crust and magmas derived by reworking of older crust. The outcomes of Dr Belousova's studies allowed refinement, testing and expansion of recent competing models for the evolution of the continental crust through time.

2015 John Booker Medal

Associate Professor Kylie Catchpole

Australian National University

Associate Professor Kylie Catchpole's research focuses on using nanotechnology to increase the light absorption in solar cells to make them cheaper and more efficient. Her work on plasmonic solar cells was named as one of the top 10 emerging technologies in 2010 by MIT Technology Review, and in 2013 she was awarded a Future Fellowship from the Australian Research Council. Associate Professor Catchpole has published over 80 papers and her work has also been featured in the news sections of Science magazine and The Economist. She completed her PhD at the Australian National University in 2001, and was a postdoctoral fellow at the University of New South Wales and FOM Institute AMOLF in Amsterdam before returning to the Australian National University.

The bright future of solar energy

The price of solar electricity is now lower than the retail price of conventional electricity in many parts of Australia, and solar panels have been installed on over one million roofs across the country. Globally, renewables now account for more than half of new electricity capacity. Associate Professor Catchpole will give an overview of the astonishing growth in solar to date, and what we can expect for the future. The presentation will include her research on using metal nanoparticles, which act like antennas to direct light into solar cells and improve their efficiency.

Christopher Heyde Medal

Dr Luke Bennetts

University of Adelaide

Dr Luke Bennetts models and analyses waves in random and complex media. He focuses on modelling ocean waves in the polar seas and looks at their impact on the sea ice cover there. He is at the forefront of integration of mathematical wave–ice interaction models into large-scale models used for operational safety forecasting and climate studies. He is also leading laboratory experimental validation of the mathematical models and the development of new, highly nonlinear models.

Of ocean waves and sea ice

The outer fringes of the sea-ice-covered ocean are some of the most inaccessible and inhospitable places in the world. Ocean surface waves are present in this region—they break up the ice cover, creating a highly dynamic and hazardous environment, and leave the ice cover weaker and more susceptible to warming temperatures. Modelling this geophysical phenomenon is necessary for accurate operational safety forecasts and to predict the fate of sea ice in the era of climate change. Mathematically, it's a highly-nonlinear, multi-scale problem, involving theories of waves in random media and hydrodynamics of viscoelastic bodies. Dr Bennetts will summarise the mathematical models and some of the supporting laboratory and field experiments.

Fenner Medal

Associate Professor Jane Elith

University of Melbourne

Associate Professor Jane Elith specialises in species distribution models—statistical models that describe relationships between the occurrence or abundance of species and the environment. Associate Professor Elith has made outstanding original academic contributions to species modelling by authoring highly cited guides to methods, helping develop and extend methods appropriate for typical data types, and testing methods and exploring their uncertainties. Her research has important applied significance because species distribution modelling is key in many aspects of species management, including understanding current distributions of threatened species, predicting how distributions might change in future, supporting threat management, and controlling invasive species. Associate Professor Elith is a Thomson Reuters Highly Cited Researcher (2014 and 2015), placing her in the top 1% of scholars internationally. She was awarded the 2015 Prime Minister's prize for Life Scientist of the Year.

Species, distributions and models

Knowledge about where plants, animals and diseases occur is limited by available data for the vast majority of species. Yet understanding species distributions is critical when managing threatened species, controlling threatening processes, predicting changes in distribution, and managing landscapes and biological invasions. Species distribution models, and statistical models that describe relationships between the occurrence and abundance of species and the environment, have become fundamental to these predictions. Associate Professor Elith will talk about the models, their application, and challenges and progress in using these with typically available data.

2016 John Booker Medal

Professor Paolo Falcaro

Graz University of Technology

Professor Paolo Falcaro is a professor in Biobased Materials and Technologies at Graz University of Technology (TuGraz—Austria). He received his PhD in materials engineering in 2006 from

Bologna University, Italy. From 2005 to 2009 Professor Falcaro worked at Civen/Nanofab (Italy) as manager of the sol-gel technological platform for industrial applications. In 2009 he joined CSIRO (Melbourne), extending the expertise from sol-gel and device fabrication to metal-organic frameworks. In 2011 Professor Falcaro received the ARC DECRA award and he started his own research group at CSIRO, progressing from group leader to team leader in 2014. In 2016 he moved to TuGraz.

Think small, tackle big problems

Among the different emerging global challenges, environmental remediation, early detection of contagious pathogens and the delivery of effective pharmaceuticals are considered important problems. Materials with features in the nanometre size range are promising candidates to tackle these challenges. Professor Falcaro will focus on the importance of engineering aspects related to nanoporous materials and nanoparticles using approaches recently proposed by him and his research team.

Ruth Stephens Gani Medal

Associate Professor Geoffrey Faulkner

Mater Research Institute
University of Queensland

Associate Professor Geoffrey Faulkner is a leading researcher in the field of genomics, where computers can be combined with high-throughput machines to analyse the DNA found in individual human cells. In recent work, Associate Professor Faulkner and his team have discovered unusual genetic changes in neurons associated with the activity of mobile DNA, a type of 'jumping gene'. This variation means that each neuron in the brain presents a unique genome that is slightly different to every other cell in the same person's brain. Interestingly, the parts of the genome most important for neurons to function normally are the most likely to carry changes associated with mobile DNA activity. Associate Professor Faulkner's work has major implications for how we view healthy brain function, and may provide opportunities to better understand mental health and neurodegenerative conditions.

Jumping genes in the human brain

Over the last five years, Professor Faulkner's research team has discovered unusual genetic changes in neurons due to the activity of mobile DNA—a type of 'jumping gene'. This variation means that each neuron in the human brain presents a unique genome that is slightly different to every other cell in the same person's brain. Strikingly, those parts of the genome most important for normal neuronal function are the most likely to carry mutations. His team's recent experiments suggest that mobile DNA behaves differently in the brains of schizophrenia and Alzheimer's disease patients, compared to healthy individuals. The team also observed a general reduction in mobile DNA content as the brain ages, suggesting that this process may be an arbiter of neuronal death. This work has major implications for how neurobiology and neurological disease are viewed.

Frederick White Prize

Associate Professor Michael Ireland

Australian National University

Associate Professor Michael Ireland works at the boundary of astronomical instrumentation and observational astronomy, specialising in high angular resolution astronomy, exoplanets and the life cycles of solar-type stars. He obtained his PhD from the University of Sydney in 2006, where he studied the death throes of stars like the Sun using an instrument he built for the Sydney University Stellar Interferometer. He has since worked in fellowship or faculty positions at the California Institute of Technology, the University of Sydney, Macquarie University and the Australian Astronomical Observatory. In his current Future Fellowship at the Australian National University, he is imaging faint traces of infra-red light from newly formed exoplanets using the Keck telescope, while continuing to develop the next generation of optical and infrared instruments with his research group. He is the project scientist for the Gemini High-Resolution Optical Spectrograph, is developing the Veloce exoplanet search spectrograph for the Anglo-Australian Telescope and is acting as project architect for the international Planet Formation Imager project.

Zooming in on planetary birth and stellar death

The discovery frontier in the fields of planetary birth and solar-type stellar death is at an angular resolution scale of 0.01 seconds of arc. This is the scale where, for the nearest targets in our galaxy, light from newly formed

giant planets can be separated from their host stars, and where layers of gas and dust can be seen lifting off atmospheres of dying solar-type stars. Associate Professor Ireland will outline the key technologies of adaptive optics and optical interferometry that allow us to reach these resolutions, and will share his vision of the next bold steps where the Planet Formation Imager will see systems of forming planets, and extreme adaptive optics will show us the reflected light from the nearest habitable planets.

Jacques Miller Medal

Associate Professor Katherine Kedzierska

University of Melbourne
Peter Doherty Institute for Infection and Immunity

Associate Professor Katherine Kedzierska's research provides insights into the mechanisms underlying generation of immunity towards viral infections. Her PhD research elucidated immunity to HIV infection and the mechanisms of disease pathogenicity. As an NHMRC Peter Doherty Fellow at the University of Melbourne, Associate Professor Kedzierska undertook research into the key mechanisms of immunological T cell memory formation and persistence. Subsequently, as an NHMRC RD Wright Fellow, she established her independent research at the University of Melbourne. Her studies investigate human immunity to pandemic and newly emerged influenza viruses, with the ultimate goal of understanding the potential of 'universal' protective T cell immunity. Her work looks at why some individuals, including the young, the elderly and Indigenous populations, are highly vulnerable to severe or fatal influenza disease. During the emergence of a new avian influenza virus, H7N9, in China, she played a key role in deciphering the immune networks responsible for recovery from severe viral pneumonia.

Immunity to pandemic and newly emerged influenza viruses

In contrast to the current antibody-mediated and strain-specific influenza vaccines, T cells directed at conserved internal proteins elicit broad immunity against seasonal and pandemic influenza viruses. To provide insights into universal immunity against influenza viruses, Associate Professor Kedzierska will explain how her team dissected the prominent human influenza-specific CD8+ T cell populations across different HLA types and across different ethnicities. The data suggested that some groups, especially the Alaskan and Australian Indigenous people, would be particularly vulnerable to a novel avian-origin A/H7N9 influenza virus. The team found that a diversity of response mechanisms contribute to resolution and survival. The research illustrates the importance of robust CD8+ T-cell memory for protection against severe influenza disease caused by newly-emerging influenza viruses.

Anton Hales Medal

Professor John Paterson

University of New England

Professor John Paterson is recognised globally as a key player in investigations of early animal evolution. He is one of Australia's leading researchers on Cambrian (c. 500 million-year-old) marine faunas of Gondwana, using these important fossils to answer major questions relating to evolution, biogeography and palaeoecology during the biggest animal radiation in the history of life—the Cambrian 'explosion'. He has also used these fossils in the relative dating and correlation of strata around the globe in order to refine the geologic timescale. His recent research has focused on the documentation of the Emu Bay Shale biota on Kangaroo Island in South Australia—a site of exceptional fossil preservation, including soft tissues such as muscle and digestive glands. His biggest discoveries to date include the oldest complex eyes in the fossil record, including those of the Cambrian apex predator Anomalocaris, revealing that powerful vision evolved extraordinarily quickly in some of the earliest animals.

The rise of animals over 500 million years ago: an Australian perspective

Professor Paterson will explain why the Cambrian Period (541 to 485 million years ago) is arguably the most important phase in the evolution of multicellular life. The event known as the Cambrian 'explosion' embodies the proliferation of marine organisms and the first appearance of most animal groups familiar to us today. It also heralds the growth of ecological complexity, including the advent of predator-prey relationships. He will describe how the early Cambrian (515 million-year-old) Emu Bay Shale on Kangaroo Island provides a critical window into the Cambrian world by giving a glimpse of complete organisms and their communities, rather than the more common preferential preservation of hard parts in the fossil record. Some of the biggest discoveries to date include the oldest complex eyes, revealing that powerful vision evolved extraordinarily quickly in some of the earliest animals.

Pawsey Medal

Associate Professor Ilya Shadrivov

Australian National University

Dr Ilya Shadrivov is a pioneer in the development of new materials, called nonlinear metamaterials, which are composite structures with carefully designed properties that are not found in nature. These materials can manipulate light and other electromagnetic waves in many unusual ways. Dr Shadrivov's achievements include the first experimental demonstration of such nonlinear metamaterials, and a substantial contribution to the development of novel structures which will be used for the next generation of photonics and communication technologies. Dr Shadrivov is also working on metamaterials that will be used in novel antennas, which radiate electromagnetic waves in chosen directions with higher intensities, rapidly scanning the surrounding environment. This technology is in high demand for many applications in modern industry.

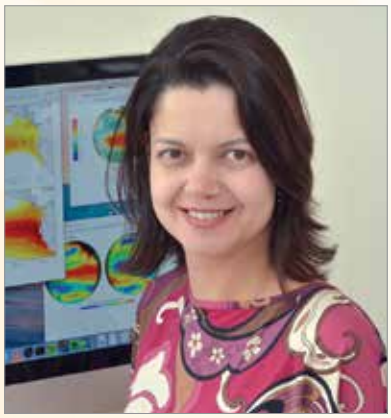
Beyond natural materials

We need various materials to make devices that manipulate light and other electromagnetic waves; for example, we use glass lenses to focus light. The number of natural and chemically synthesised materials is limited, and this limits our capabilities in controlling electromagnetic waves. Dr Shadrivov will explain how metamaterials, which are composite structures, can be designed to exhibit properties that are not found in any natural materials. Metamaterials can manipulate electromagnetic waves in many unusual ways, opening new avenues in electromagnetism, with applications over the entire frequency spectrum from microwaves to visible.

Dorothy Hill Award

Dr Andréa Taschetto

UNSW Australia



Dr Andréa Taschetto investigates how conditions in the tropical oceans affect Australian climate. Her research has significantly advanced our understanding of large-scale oceanographic and atmospheric phenomena in the tropical Pacific and Indian oceans, and their effects on regional climate variability. She is widely recognised for her important discovery of the rainfall impacts over Australia associated with a different type of El Niño, known as El Niño Modoki, and the physical mechanisms by which this relationship exists. She has also uncovered how the Pacific Ocean can remotely influence the conditions of other ocean basins, such as the Indian Ocean, which in turn modulates Australian precipitation. The findings of her research have significant implications for predictability of El Niño climate impacts in Australia and other regions of the globe.

Exploring the links between the tropical oceans and Australian climate

From time to time, the Pacific Ocean warms in an event known as the El Niño Southern Oscillation (ENSO). This unusual warming covers approximately one third of the tropics and causes major changes in oceanic and atmospheric circulation, impacting climate worldwide. Over Australia, El Niño is generally associated with dry conditions to the eastern half of the continent. However, El Niño comes in different shapes and sizes, causing non-linear responses in regional climate. In addition, ENSO can interact with climate variability in other ocean basins, thus affecting Australian climate indirectly. In this talk, Dr Taschetto will show how a different type of El Niño, termed El Niño Modoki, impacts Australian rainfall and will discuss the complex relationship between tropical oceans in modulating Australian climate.

Gottschalk Medal

Professor Ostoja Steve Vucic

University of Sydney
Westmead Hospital

Professor Steve Vucic is an internationally recognised translational researcher in amyotrophic lateral sclerosis (ALS) and a clinical academic at the Western Clinical School and Westmead Hospital, University of Sydney. His pioneering research has uncovered novel mechanisms that underlie the development of

neurodegeneration in ALS. Professor Vucic has identified important processes that contribute to the triggering and propagation of ALS, leading to the identification of novel therapeutic targets and approaches. In addition, Professor Vucic has invented a much-needed diagnostic technique for ALS, enabling an earlier diagnosis at a point where the disease may be amenable to neuroprotective therapies, allowing earlier recruitment of patients into clinical trials. Professor Vucic has also made significant research contributions to the understanding of molecular and genetic processes underlying relapsing and progressive forms of multiple sclerosis.

Pathophysiology of amyotrophic lateral sclerosis: the role of cortical hyperexcitability

Amyotrophic lateral sclerosis (ALS) is a fatal neurodegenerative disease of the human motor system resulting in progressive wasting and paralysis of voluntary muscles. Two Australians die every day from this deadly disease and at present little is understood about the cause. A key unresolved issue relates to the relationship between upper and lower motor neuron dysfunction, a pathognomic feature in ALS. While some have proposed that upper motor neuron dysfunction (namely cortical hyperexcitability) was a primary event, driving the disease, others have suggested that the disease begins within the lower motor neurons, and still others have argued for an independent process. Professor Vucic will explain how his research has identified cortical hyperexcitability as a primary event in ALS potentially regulating the rapid disease progression. Importantly, his research has identified potentially novel therapeutic targets and treatment strategies for ALS, such as cell based approaches, which could ultimately prove efficacious.

Gustav Nossal Medal

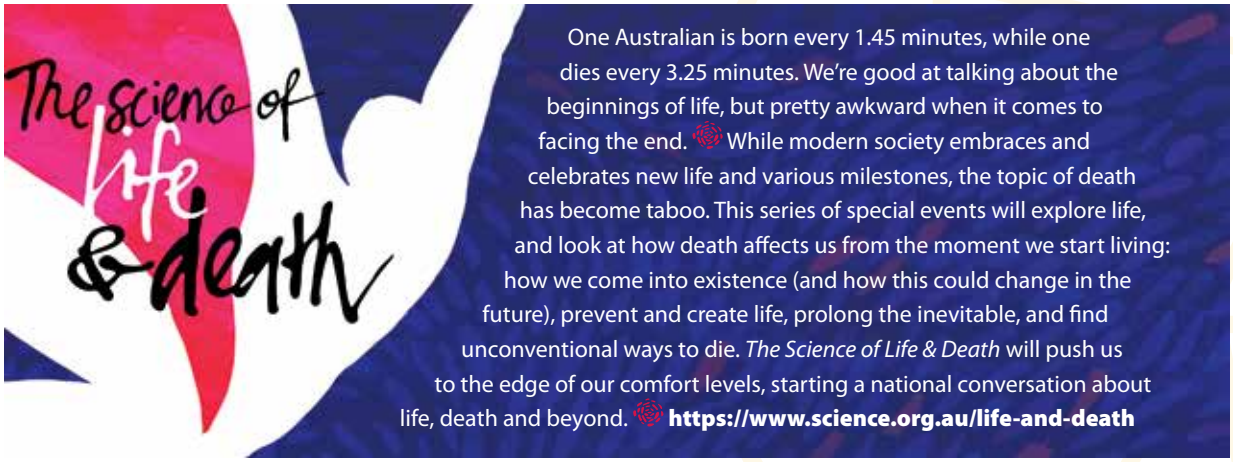
Professor David Wilson

Burnet Institute

Professor David Wilson is at the forefront of allocative efficiency in health—that is, the maximisation of health outcomes using the most cost-effective mix of health interventions. The aim is to assist decision-makers, program managers and funding partners achieve maximum impact with available funding in low- and middle-income countries towards eliminating HIV, tuberculosis and other diseases. Professor Wilson's work has informed global guidelines, as well as resource need estimates and priority areas for numerous countries and global health agencies.

Achieving maximal health impact with available HIV resources

The maximisation of health for populations is an aspiration for most societies and governments. Over the last 15 years there has been an unprecedented increase and systematic shift of resources from high-income to lower-income settings for international aid to help achieve better health outcomes. Over this same period there has been a revolution in proven, effective and feasible HIV-related interventions. Policy makers, funders and managers of program implementers face a difficult task to ensure that resources are allocated optimally. Professor Wilson will explain how the number of people at risk of acquiring HIV can be reduced by 10–30% in concentrated epidemic settings and, in generalised epidemic settings, how the number of people living with HIV who attain viral control and improved health can increase by 20–40% without additional resources. His research has had real life impacts in many countries.



Early- and mid-career researcher workshops

2.00PM – 5.30 PM, WEDNESDAY 25 MAY

Topic 1: Managing your time and staff

Fenner Room / Library, level 1, Shine Dome

Chaired by Associate Professor Jodie Bradby and Dr Anselm Enders

A career in science creates multiple demands on your time. As you progress through your career, supervising your first PhD student evolves into managing a team of researchers. Where do you gain the skills that allow you to balance your own research and service to your workplace with effectively managing your staff and helping them manage their time? Not to mention finding some work–life balance! Associate Professor Jodie Bradby and Dr Anselm Enders will discuss how they find time for it all and offer some tips to help you navigate the time crunch. They will also discuss strategies to help you manage employees and students at various career points.

Associate Professor Jodie Bradby

Associate Professor Jodie Bradby is a physicist who completed her PhD at ANU in 2003. She is currently an ARC Future Fellow and Associate Professor at the Australian National University where she leads a group focused on developing new functional materials via high-pressure synthesis and understanding the mechanical properties of a wide range of materials, from semiconductors and metals to plant cells and corals. In 2015, Associate Professor Bradby was awarded the Australia Institute of Physics, Women in Physics Lectureship. Jodie has a strong interest in interdisciplinary research, gender issues in STEM and science outreach.

Dr Anselm Enders

Dr Anselm Enders obtained his medical degree in 2003 from the University of Freiburg, Germany. After two years training in pediatrics he moved to Canberra to join the group of Professor Chris Goodnow at the John Curtin School of Medical Research (JCSMR) at ANU. Since 2012 he has been an independent group leader and is currently an associate professor in the Department of Immunology and Infectious Disease at JCSMR. Dr Enders' research focuses on understanding novel pathways that control the development and function of antibody-producing B cells and how defects in these pathways contribute to primary immunodeficiency diseases.

Topic 2: Broadening your vision: partnering with industry

Becker Room, ground floor, Shine Dome

Chaired by Dr Michael Crichton and Associate Professor Drew Evans

'University–industry collaboration' has become one of the most widely discussed topics in Australia of late. Have you ever wondered what it actually means? Or better yet, ever thought how you could get involved? Dr Michael Crichton and Associate Professor Drew Evans will work through the details of what a successful partnership entails. They will draw on their experiences working in industry and transitioning back to academia, and discuss the challenges and strategies for developing careers working in partnership with industry.

Dr Michael Crichton

Dr Michael Crichton is a Postdoctoral Fellow at the Australian Institute for Bioengineering and Nanotechnology at the University of Queensland (UQ). His research focuses on the mechanical engineering interface between biomaterial tissues and novel micro-devices for therapeutic or diagnostic purposes. After completing a PhD in biomedical engineering at UQ, Dr Crichton joined Vaxxas, a start-up company working to translate a micro-medical device from laboratory to human clinical trials. He has now returned to an academic role, but continues to work on projects with commercial applications. He is passionate about taking research towards public use and is Deputy Chair of the EMCR Forum.

Associate Professor Drew Evans

Associate Professor Drew Evans is a research leader in the Future Industries Institute at the University of South Australia. His research focuses on the development and translation of fundamental thin film science. This covers all aspects from the fundamental physics and chemistry of a material, to the methods for fabrication, and how the material and manufacturing go together to make robust product for industry. Of particular interest is the vapour and vacuum deposition of conducting polymers, metals, and dielectric materials.

Topic 3: Creating good mentor-mentee relationships

Board Room, level 1, Ian Potter House

Chaired by Dr Bernadette Fitzgibbon and Dr Kate Hoy

Most of us know the value of a good mentor. But we don't always know where to find one, what qualities to look for, or what to expect. By the same token, as we progress in our careers, we may take on a mentoring role—yet we are rarely formally trained to do so, and may not fully understand how to best help junior scientists shape their career pathways. Despite this lack of clarity, mentoring is fundamental to the success and wellbeing of researchers at all levels. In this workshop, Associate Professor Kate Hoy and Dr Bernadette Fitzgibbon will draw on their own experiences in developing and managing mentor–mentee relationships through the ECMR stage and into independence. Participants will be encouraged to share their own experiences, expectations and challenges.

Dr Bernadette Fitzgibbon

Dr Bernadette Fitzgibbon is an NHMRC Research Fellow at Monash University. Her research utilises neuroscientific techniques including transcranial magnetic stimulation, magnetic resonance imaging and electroencephalography to explore the neurobiology of pain perception and to develop novel treatment approaches for chronic pain. Her work also investigates social cognition and how pain can be used as a model to explore how we understand the thoughts, feelings and actions of other people. She has received several awards for her research including the 2014 Bethlehem Griffith Foundation Young Researcher Award and a 2014 Tall Poppy Award from the Australian Institute of Policy and Science.

Associate Professor Kate Hoy

Associate Professor Kate Hoy is an NHMRC Career Development Fellow, Clinical Neuropsychologist and Head of the Cognitive Therapeutics Group within MAPrc at Monash University. Her research investigates the cognitive outcomes of brain stimulation techniques with a view to developing novel biological treatments for cognitive impairments.

Since graduating from her doctorate of clinical neuropsychology in 2007, Associate Professor Hoy has developed an outstanding track record, with 70 scientific articles, 2 book chapters, and over $2.7 million in research funding. She is passionate about communicating science to the public; not only her own research, but the importance and impact of science in general. She is also a passionate science advocate, having served in leadership positions on national committees dedicated to helping secure the future of Australian science.

Topic 4: How to pitch your research to the media

Board Room, ground floor, Ian Potter House

Chaired by Dr Tim Dean

Want to get your research out to a wider audience but you're not sure how to get the attention of journalists? Dr Tim Dean, Science and Technology Editor at The Conversation, will discuss how to pitch your research to a range of different media outlets, and how to talk about your work once you have their attention. He will explain what journalists and editors are looking for in a story, how to frame your research so it appeals to their audience, and practical tips on how to communicate with journalists and avoid some common pitfalls.

Dr Tim Dean

Dr Tim Dean has been a science journalist and editor for nearly 20 years. He has formerly edited Cosmos, Australian Life Scientist and PC & Tech Authority magazines, and his writing has appeared in publications such as New Scientist, Popular Science, New Philosopher, The Sydney Morning Herald and the ABC's The Drum. Dr Dean is currently Science and Technology Editor at The Conversation, which is an online media outlet dedicated to bringing expert academic voices to the public. He also has a doctorate in ethics and the philosophy of biology from the University of New South Wales.

Annual dinner

DINNER ADDRESS

Dr Alan Finkel

Dr Finkel commenced as Australia's Chief Scientist on 25 January 2016. He is Australia's eighth Chief Scientist. Dr Finkel has an extensive science background as an entrepreneur, engineer, neuroscientist and educator. Prior to becoming Chief Scientist, he was the Chancellor of Monash University and President of the Australian Academy of Technology and Engineering (ATSE). Dr Finkel was awarded his PhD in electrical engineering from Monash University and worked as a postdoctoral research fellow in neuroscience at the Australian National University. In 1983 he founded Axon Instruments, a California-based, ASX-listed company that made precision scientific instruments used at pharmaceutical companies and universities for the discovery of new medicines. After Axon was sold in 2004, Dr Finkel became a director of the acquiring company, NASDAQ-listed Molecular Devices. In 2006, he returned to Australia and undertook a wide range of activities. He led the amalgamation that formed the Florey Neuroscience Institutes; he became Chair of the Australian Centre of Excellence for All-Sky Astrophysics (CAASTRO) and was a director of the ASX-listed diagnostics company Cogstate Limited. He was Executive Chair of the educational software company Stile Education, Chair of Manhattan Investment Group, Chief Technology Officer of Better Place Australia and Chair of Speedpanel Australia.

Symposium speakers

CONVENOR

Professor M. 'Srini' Srinivasan FAA FRS

Professor Srinivasan is presently Professor of Visual Neuroscience at the Queensland Brain Institute and the School of Information Technology and Electrical Engineering of the University of Queensland. Professor Srinivasan holds an undergraduate degree in electrical engineering from Bangalore University, a master's degree in electronics from the Indian Institute of Science, a PhD in engineering and applied science from Yale University, a DSc in neuroethology from the Australian National University, and an honorary doctorate from the University of Zurich. His research has been recognised by the award of the Fellowships of the Australian Academy of Science (1995), of the Wissenschaftskolleg zu Berlin (1996), of the Royal Society of London (2001), and of the Academy of Sciences for the Developing World (2006), the Australia Prime Minister's Science Prize (2006), the UK Rank Prize for Optoelectronics (2008), the Distinguished Alumni Award of the Indian Institute of Science (2009), the Membership of the Order of Australia (AM; 2012), the Queensland Science Championship (2014), and the Harold Spencer-Jones Gold Medal of the Royal Institute of Navigation, UK (2014).

CHAIRS

Professor Andrew Holmes AM PresAA FRS FTSE

Professor Andrew Holmes is a Laureate Professor of the School of Chemistry at The University of Melbourne. In October 2004 he was appointed ARC Federation Fellow and inaugural VESKI Fellow at the Bio21 Institute at The University of Melbourne and at CSIRO Molecular and Health Technologies. Professor Holmes has been recognised for his groundbreaking work on light-emitting polymers. He has also been the recipient of a long list of awards including the Royal Society's Royal Medal and the Descartes Prize. He was elected to the elected to the Australian Academy of Science in 2006 and served as Foreign Secretary from 2010 to 2014. He became President of the Academy in May 2014.

Professor Jan Provis

Professor Jan Provis is internationally recognised for her work on development of the primate retina, for her contributions to understanding the predisposing features of the human retina to age-related macular degeneration (AMD), and for helping to characterise the inflammatory aspects of AMD. She has authored more than 110 scientific articles, with a citation average of more than 45 per paper. Since 2012 her work has received more than 400 citations each year. Professor Provis is a member of the ANU Council (2015–16) and a member of the ANU Medical School Executive. She is Associate Dean, ANU Medical School where she oversees curriculum management, teaching and learning in Years 1 and 2 of the medical program. She chairs the Early Career Academic Development Committee, College of Medicine Biology and Environment. This committee is tasked with supporting and providing professional

development opportunities for early career academics (ECA). Professor Provis also chairs the Research Advisory Group for Retina Australia—a community-based organisation that supports people affected by retinal degenerative disease, and fundraises for research. She has recently served as a grant review panel member for the National Health and Medical Research Council.

Dr Judith Reinhard

Dr Judith Reinhard obtained a PhD from the University of Bayreuth, Germany in 1997. She was awarded a postdoctoral Fellowship from the German Academic Exchange Service (DAAD) to work at CSIRO in Australia in 1998, followed by a Fellowship from the German Research Council (DFG) to work at CNRS in France. In 2002, Dr Reinhard returned to the Australian National University with a Fellowship from the Alexander-von-Humboldt Foundation. In 2007, she was appointed Senior Fellow and group leader at the Queensland Brain Institute, where she established a number of international exchange programs between Australia and Germany. In 2015, Dr Reinhard was recruited to the German Embassy in Canberra as Science and Innovation Counsellor for the German government. In this role she uses her extensive international experience in the higher education and research sector to foster partnerships between German and Australian institutions, respective funding agencies and industry.

KEYNOTE

Dr Nicholas Opie

SPEAKER SPONSOR

Dr Nicholas Opie is a biomedical engineer with experience in neural prostheses. Dr Opie was awarded his PhD in 2012 for research developing a bionic eye. He was employed as the Surgical Program Coordinator on Bionic Vision Australia's retinal prosthesis project, and was integral in development and preclinical validation of the technology designed to restore rudimentary vision to the profoundly blind. This device was implanted in three patients in 2014 with great success. In 2012, Dr Opie was awarded a $1.33 million grant from US defence organisation DARPA to develop a minimally invasive brain–machine interface. This funding, and subsequent funding totalling more than $5.5 million has enabled Dr Opie to establish and co-lead the Vascular Bionics Laboratory within the Department of Medicine at the University of Melbourne; a laboratory that has grown to support more than 20 graduate and undergraduate researchers. Dr Opie is leading the research team conducting preclinical safety and efficacy trials on a device capable of recording neural information from within a blood vessel, which may enable direct brain control of wheelchairs, exoskeletons and computers to people with paralysis as early as 2017. Dr Opie is the founding CTO of SmartStent, a company incorporated to translate endovascular bionic technology into clinical application.

Minimally invasive neural interface

Dr Opie's team has developed a minimally invasive brain–machine interface. This is a device that can record brain waves or thoughts and convert these signals into commands that can be used to control wheelchairs, exoskeletons or prosthetic limbs. He envisages that this technology will return mobility and independence to people with paralysis. The team's technology is unique in that it uses blood vessels to deliver its device to the brain. This avoids surgical risks associated with accessing the brain by removing a portion of the skull. In preclinical trials, the team has demonstrated its technology can be implanted easily and can safely record movement-related neural information for longer than six months. The team aims to conduct a world-first human trial in 2017.

Professor Anthony Burkitt

Professor Anthony Burkitt has worked in a number of areas of medical bionics, including cochlear-implant speech processing, neuro-engineering, computational neuroscience and bio-signal processing for epilepsy. His research has been instrumental in the development of new cochlear-implant speech-processing strategies, visual stimulation paradigms for retinal implants, methods for detecting and predicting seizures, and the use of electrical stimulation for seizure abatement in epilepsy. Professor Burkitt was previously Deputy Director of the

Bionic Ear Institute (now the Bionics Institute) and held research positions at the Australian National University and universities in Britain and Germany. He completed his undergraduate studies in 1980 in physics at the Australian National University and his PhD in 1983 in theoretical physics at the University of Edinburgh.

The challenge of restoring sight with vision prostheses

Vision prostheses aim to deliver functional vision and improved quality of life for patients with degenerative vision loss caused by conditions such as retinitis pigmentosa and age-related macular degeneration. The Bionic Vision Australia research program developed a prototype retinal prosthesis that has been tested with three patients. The images that are captured on a miniature camera mounted on glasses are transformed into electrical signals that directly stimulate surviving neurons in the retina. This study demonstrated that the suprachoroidal electrode placement of the implant developed by the team is surgically feasible and mechanically stable, and showed that it delivered functional vision outcomes for patients with degenerative vision loss caused by conditions such as retinitis pigmentosa. The results provide strong support for the surgical approach and the technology adopted, providing a solid foundation for ongoing and future developments for more advanced implant systems to be outlined by Professor Burkitt.

Professor John Fraser

Professor John Fraser is a graduate of the University of Glasgow, where he received fellowships in medicine and anaesthesia during his basic ICU training. He completed his training in Brisbane prior to completing a PhD on burns and smoke inhalation injury at the University of Queensland. Today, Professor Fraser is a pre-eminent intensivist at the Prince Charles Hospital, where he founded and leads the multidisciplinary Critical Care Research Group, the largest group of its kind in Australasia. Since its inception in 2004, it has earned more than $29 million in grants and industry funding. In 2014, the group was awarded The Centre for Research Excellence in Australasia, looking at the development and utilisation of bionic hearts and lungs, collaborating throughout Australia, Japan, Singapore, Malaysia and China.

Bionic hearts and lungs—is it prime time yet?

Cardiovascular disease is a leading cause of death and is responsible for 17% of health expenditure in the USA and 11% in Australia (2008–09). The burden of disease it imposes in terms of disability and premature death is second only to cancer. It was responsible for more deaths in Australia (nearly 50,000) than any other disease group—34% of annual mortality. The gold standard treatment of end-stage heart failure, heart transplantation, is limited by falling organ donation numbers. Artificial hearts and lungs are increasingly used to support our most critically ill patients. A greater understanding of patient–machine interaction is needed to maximise their life-preserving potential. A multidisciplinary collaboration of clinicians, engineers, allied health and policy-makers is necessary to research device-related complications, improve device components, develop clinical practice guidelines, train clinical and engineering researchers, and explore the cost benefits of this technology, ensuring all can access state-of-the-art mechanical life support. Professor Fraser will look at the progress of both ECMO and artificial hearts from a basic science perspective and its translation to clinical practice. He will examine the recent successful initiation of the Centre for Research Excellence collaborative into mechanical hearts and lungs across Oceania.

Professor Dietmar Hutmacher

Professor Hutmacher's work is aimed at transcending traditional disciplinary boundaries in order to initiate and nurture research and education programs across different disciplines. He has achieved translational research outcomes through a concerted and integrated leadership and collaboration effort including contributions from colleagues in engineering, the life science disciplines and applied clinical research. Author of more than 250 journal articles and editor of 10 books, Professor Hutmacher has more than 16,400 citations and an h-index of 64. He was awarded an ARC Future Fellowship in 2012 and the Hans Fischer Senior Fellowship at the Technical University, Munich, in 2013, and holds an Adjunct appointment at the Georgia Institute of Technology, Atlanta. Over the past 15 years in academia, he has been lead Chief Investigator, co-Chief Investigator or collaborator in grants totalling more than $50 million.

3D printing in medicine

More popularly known as 3D printing, additive manufacturing (AM) is a canopy term for a group of technologies that build physical parts through the addition of materials—

characteristically layer by layer, a process inherently different to classical machining which works via subtraction of a material block by methods such as drilling or milling. From a global industry perspective, the form and functionality of future products and services yet to be developed are, as yet, unknown, but the main driving force behind their development will be so-called key enabling technologies (KETs), among which AM is in the top 10. The Hutmacher laboratory developed a world-class research program in the convergence of tissue engineering and AM, namely additive biomanufacturing (ABM). The application of ABM represents one of the most rapidly advancing areas of biomedical sciences in which engineers, scientists and clinicians are contributing en masse to the future of human health care. This talk will review the current literature and present the work of the Hutmacher laboratory in the area of bone, cartilage and breast-tissue engineering.

Professor Michael Ibbotson

Professor Michael Ibbotson carried out his PhD in the field of neuroscience at Queen Mary University of London. He did postdoctoral research at the Australian National University, working with Professor Srinivasan and later held a prestigious ARC Research Fellowship. At ANU, he became Chair of Faculty at the Research School of Biological Sciences, Head of the Visual Sciences Department, and one of the associate directors of the ARC Centre of Excellence in Vision Science. In 2011 he became Director of the National Vision Research Institute of Australia, based in Melbourne. He is a node leader in the Centre of Excellence for Integrative Brain Function and was a chief investigator in Bionic Vision Australia. His research interests are focused on how natural visual systems see. This interest has led to a range of experimental approaches that include neurophysiology, neural imaging, eye movement recording, perceptual analysis and computer modelling.

Moving into a bionic world

The notion of the 'mad' scientist is alive and well in 2015, thanks to popular myth and children's cartoons. Partly as a result of this perception, the general public remains uneasy about the concept of implantable electronic devices. Yet, within just a few decades, it is likely that bionic devices will become commonplace, perhaps even cosmetic. Scientists are indeed mad—but in the sense of being angry, not insane. They are angry that there are so many medical conditions still to be cured and so many questions to be answered: how do we return mobility to a quadriplegic patient, for instance, or return sight to the blind? The key feature that makes implantable electronics work is that our nerve cells are electrically excitable. Neuroscientists are rapidly working out how to measure and understand the signals generated by the brain, so that we can understand what the brain is trying to do (move an arm to pick up a cup, for example). Using very small electrical currents injected through sophisticated multielectrode arrays, scientists are learning how to activate motor and sensory structures in the brain and body to generate perceptions and actions. Professor Ibbotson will look at some of the technologies that are being developed around the world and attempt to convey the excitement among we 'angry few'.

Associate Professor Katina Michael

Associate Professor Katina Michael has had industry experience in telecommunications engineering and holds cross-disciplinary qualifications in information technology and law. She is Editor-in-Chief of IEEE Technology and Society Magazine and Senior Editor of IEEE Consumer Electronics Magazine. Associate Professor Michael researches the social implications of emerging technologies with an emphasis on national security. Her most recent book is Uberveillance and the social implications of microchip implants. She is a senior member of the IEEE, actively involved in the Society on Social Implications of Technology. Associate Professor Michael has chaired two international symposiums, on Microchipping people (2010, University of Wollongong) and Wearable computers (2013, University of Toronto), and has run an annual workshop series on the social implications of national security since 2006, originally funded by the ARC Research Network for a Secure Australia.

Socio-ethical implications of the bionic era

Is Human PLUS (H+) an oxymoron? What does it really mean to be more than human? Can technology enhance us to make us something other than human? The bionic era heralds many possibilities, all of which have associated socio-ethical implications. From brain implants to help those

suffering from a major depressive disorder or spinal injury, to the printing of skin to help burns victims, to the making of bionic organs for prostheses for those awaiting transplants, there is almost no end to what can be imagined. But is bionic always better? What are the risks? Could hacking the body mean death for some bionic recipients and, for others, a complete loss of privacy and freedom? The true landscape of bionics will be realised outside the medical space in applications such as entertainment and marketing. Will this really be humanity plus or, in actual fact, humanity minus the being human?

Professor Rob Shepherd

Professor Rob Shepherd is Director of the Bionics Institute and Head of the Medical Bionics Department at the University of Melbourne. He led the preclinical team that demonstrated the safety and efficacy of Cochlear's bionic ear in both adults and children and, more recently, his team developed a prototype bionic eye as part of an Australia-wide collaboration—Bionic Vision Australia—to develop a commercial bionic eye. He has published over 200 peer-reviewed papers, given 80 invited keynote conference presentations, received $90 million of research funding and founded and chairs the Medical bionics conference series. Professor Shepherd has overseen the expansion of the Bionic Ear Institute into the Bionics Institute, broadening its research portfolio to include retinal prostheses, neurobionics (a platform technology for diseases such as epilepsy and Parkinson's disease) and bioelectronics (stimulation of visceral nerves). In 2014 he was awarded the Garnett Passe Medal at the Royal Society of Medicine, London, for his contributions to otolaryngology.

Bionic hearing, neurobionics and bioelectronics

Neural prostheses are engineered devices that record from and/or electrically stimulate excitable tissue in order to improve health outcomes. Since the introduction of the first heart pacemaker in the 1950s, there have been a number of bionic devices approved for clinical use, resulting in a dramatic impact on the quality of life of millions of people. These technologies depend on fundamental biomedical engineering principles and a thorough understanding of the anatomy and physiology of the target neural population. Professor Shepherd will provide an overview of the design principles of bionic devices, using bionic hearing for the treatment of severe hearing loss, and neurobionics (deep brain stimulation, or DBS) to reduce motor tremor in Parkinson's disease. Significantly, there are a large number of devices currently undergoing development, fuelling expectations that this field will undergo major expansion over the next decade. One example is the application of bionics to stimulate visceral nerves—bioelectronics—to treat a broad range of diseases, from arthritis to Crohn's disease. Supported by the Australian Research Council, DARPA, NHMRC, NIH and the Victorian Government.

Professor Gordon Wallace FAA FTSE

Professor Gordon Wallace's research interests include organic conductors, nanomaterials and electrochemical probe methods of analysis, and the use of these in the development of intelligent polymer systems. A current focus involves the use of these tools and materials in developing bio-communications from the molecular to skeletal domains in order to improve human performance via medical bionics, and the use of 3D printing to achieve this. With more than 700 refereed publications, Professor Wallace has attracted some 24,000 citations and has an h-index of 66. He recently published an ebook, 3D bioprinting: printing parts for bodies. Professor Wallace is an elected Fellow of the Australian Academy of Science, the Australian Academy of Technology and Engineering, the Institute of Physics (UK) and the Royal Australian Chemical Institute.

3D bioprinting: printing parts for bodies

In recent times we have witnessed medical breakthroughs enabled by advances in biomaterials science and 3D printing. These can be attributed to the emergence of 3D bioprinting. We have seen this have an impact on customised wearable prosthetics as well as implantable components (such as 3D metal-printed jaws, or heel implants) that provide structural support. Polymer-based 3D printed

structures have also been used to provide scaffolds that facilitate tissue regeneration. Often combined with other bioactive molecules these have been used for bone and cartilage regeneration. Perhaps the ultimate regenerative platform is a 3D printed structure that contains stem cells configured in an appropriate chemical and mechanical environment to induce appropriate tissue regeneration.

Professor Wallace will report on his most recent studies on printing stem cells and the impact of the printed environment on stem cell development. He will also touch on some non-technical challenges arising in this rapidly developing area of medical research: ethical and regulatory issues.

Life on the loose: species invasion and control

SCIENCE AT THE SHINE DOME 2017
THURSDAY 25 MAY

Foxes and fire ants, cane toads and Paterson's curse: Australia is home to a huge range of introduced species. Whether brought in by accident or by design, many plants, animals and diseases are harmful to the environment, to agriculture and to health. How do we monitor them? What do we do to reduce their impact, and is eradication ever possible? And how do we prevent them from coming here in the first place? Join international experts to explore how we manage invasion risks; learn the latest science in detecting and controlling introduced species; and hear how the rest of the world is learning from Australia's giant natural experiment as the climate changes and people continent-hop and trade at an ever increasing rate.

Event information

Colour coding

New Fellows

Fellows

EMCRs/Lindau participants

Awardees

Symposium speakers

Photo sessions

Please meet in the foyer where you will be directed.

Tuesday

MORNING TEA

EMCRs group photo
EMCR awardee and Lindau participants group photos

LUNCH

New Fellows group and individual photos

AFTERNOON TEA

New Fellows individual photos continued

Wednesday

MORNING TEA

Honorific Awardees (early morning session) individual photos

LUNCH

Awardee group and individual photos

Thursday

LUNCH

Symposium speakers group photo

Registration desk

The registration desk in the main foyer of the Shine Dome will be staffed at all times should you have any questions.

Luggage

A luggage cabinet is located in the main foyer of the Shine Dome. Please drop your luggage at the registration desk.

Academy shop

A small selection of Academy merchandise is available to purchase at the shop in the small foyer adjacent to the Jaeger Room.

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Please disable personal mobile hotspots as this slows down the network for all delegates.

Taxi

Canberra Elite **13 22 27**

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Bus routes

These routes drop off within walking distance of the Dome: 3, 4, 5, 7.

www.action.act.gov.au/timetables_and_maps

Parking

Limited free car parking is available in the Academy's Gordon St carpark (first come first served).

The forecourt area of the Shine Dome is 'set down and pick up' only.

Additional pay parking areas are marked on the Academy map on the inside front cover of this program.

Disabled access

Two disabled parking spaces are available within the Academy car park. The Theatre is equipped with wheelchair access and facilities: please see the registration desk if you require more information.

Quiet space

A quiet space is available in the Fenner Room and Basser Library on level 1 of the Shine Dome.

Hearing Loop

The Ian Wark Theatre is equipped with a hearing loop. Please look for seats in the lower area of the theatre with a gold plaque indicating a hearing loop. An IR hearing loop is available for the first floor. Please see reception staff to obtain a device.

Coach timetable

Thursday airport shuttle

4.00 pm From the Shine Dome **to** the airport

Contacts

The following Academy staff will be available to assist you. Please don't hesitate to call them.

General enquiries

Mitchell Piercey	0466 271 430
Ray Kellett	0411 156 801

Lindau delegates

Meaghan O'Brien	0438 458 637

Early- and mid-career researchers

Sandra Gardam	0406 754 600

New Fellows

Karen Holt	02 6201 9406

Awardees

Dominic Burton	0404 845 190

Media

Kylie Walker	0405 229 152

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