Monash University, Faculty of Science
2022 Graduate Research Conference Program

MONASH University
Science

Welcome Address

Welcome to the Faculty of Science 2022 Graduate Research Conference

We would like to welcome you to the inaugural Faculty of Science Graduate Research Conference. This conference provides an opportunity for graduate research students to develop and refine their presentation skills, network with peers and understand how to effectively communicate research impact.

The conference runs over four days and includes workshops, panel discussions, keynote speakers, presentation and poster sessions and the Faculty of Science 3 Minute Thesis competition.
We would like to thank Associate Professor Jen Martin and Professor Neville Nicholls, our amazing keynote speakers.
We would also like to thank the academics, alumni, The Research Impact Academy and professional staff involved in our workshops, panel discussions and the 3MT competition.
And of course a big thank you to every graduate research student who will be presenting and taking part in the conference.

The conference is kindly funded by the Faculty of Science.

This booklet includes:

- Location
- Program
- Speaker order
- Keynote Speakers
- Workshops
- Alumni Panel Session
- Faculty of Science 3MT
- Presentation Impact Statements

We encourage attendees to share their photos on social media using the hashtag **#ourimpactourfuture**

Please ENJOY the conference!!

Kind regards,
Faculty of Science 2022 Graduate Research Conference Committee

The Faculty of Science Graduate Research Conference Committee wishes to acknowledge the people of the Kulin Nations, on whose land we are gathered today. We pay our respects to their Elders past, present and future.

Conference location

Conference will be hosted in person at:
Monash, Clayton Campus *in*
Lecture Theatre E7 - 14 Alliance Lane.
The conference will also be streamed online to School of Science students at Monash University Malaysia.
Posters and morning tea/lunch will be available in Room G29 and G33 across the hall from Lecture Theatre E7.
Workshop 2 will be held in Rm G29/G30 New Horizons Building, 20 Research Way.

Registration: please ensure you bring your Monash ID card

Conference program

Day 1: Monday June 6th 2022

TIME (AEST)	Day 1	Location
9:15-9:30	Registration	Lecture Theatre E7
9:30-9:45	Welcome	Lecture Theatre E7
9:45-10:30	Keynote 1 - A/Prof. Jen Martin	Lecture Theatre E7
10:30-11:00	*Morning Tea Break*	G29 and G33
11:00-1:00	Oral Presentation Session 1	Lecture Theatre E7
1:00-2:00	*Lunch (incl. headshots*)*	G29 and G33
2:00-3:15	Oral Presentation Session 2	Lecture Theatre E7
3:15-3:30	Lightning Talks	Lecture Theatre E7
3:30-4:00	Poster presentation/Afternoon Tea	G29 and G33
4:00-4:15	*Close*	Lecture Theatre E7

* Professional Headshots will be available for all graduate research students in the foyer.

Day 2: Tuesday June 7th 2022

TIME (AEST)	Day 2	Location
9:15-9:30	Registration	Lecture Theatre E7
9:30-10:30	Alumni Panel	Lecture Theatre E7
10:30-11:00	*Morning Tea*	G29 and G33
11:00-12:00	Workshop 1 - How to Write for The Conversation	Lecture Theatre E7
12:00-12:15	*Break*	G29 and G33
12:15-1:15	Oral Presentation Session 3	Lecture Theatre E7
1:15-2:00	*Lunch (incl. headshots*)*	G29 and G33
2:00-3:30	Oral Presentation Session 4	Lecture Theatre E7
3:30-3:40	Monash University Malaysia Poster Presentations	Lecture Theatre E7
3:40-4:00	Poster presentation/ Afternoon Tea	G29 and G33
4:00-4:15	*Close*	

* Professional Headshots will be available for all graduate research students in the foyer.

Day 3: Wednesday June 8th 2022

TIME (AEST)	Day 3	Location
9:15-9:30	Registration	Lecture Theatre E7
9:30-10:15	Keynote 1 - Prof. Neville Nicholls	Lecture Theatre E7
10:15-10:30	*Morning Tea*	G29 and G33
10:30-12:15	Oral Presentation Session 5	Lecture Theatre E7
12:15-1:00	*Lunch*	G29 and G33
1:00-4:00	Workshop 2 - Research Impact (Incl. break)	Rm G29/30, New Horizons Building
4:00-4:15	*Close*	

Day 4: Thursday June 9th 2022

TIME (AEST)	Day 4	Location
9:15-9:30	Registration	Lecture Theatre E7
9:30-10:15	Oral Presentation Session 6	Lecture Theatre E7
10:15-11:00	*Break (no morning tea provided)*	G29 and G33
11:00-12:15	Faculty 3 Minute Thesis (3MT)	Lecture Theatre E7
12:15-12:30	Closing Session	Lecture Theatre E7
12:30-1:30	*Lunch*	G29 and G33
1:30-1:45	*Close*	

Speaker Order

Oral presentation Session 1 *Session Chairs Sam Dekkers and Adam Kennedy*	
11:00-11:15	**MD Anarul Haque Mondol - *School of Earth, Atmosphere & Environment*** Are traditional classes of drought appropriate to describe water shortages that affect agriculture in Bangladesh?
11:15-11:30	**Matt Carew - *School of Biological Sciences*** The Communication Gap in Climate Change Education
11:30-11:45	**Ielyzaveta Ivanova - *School of Biological Sciences*** The role of Australia's protected areas in supporting biodiversity
11:45-12:00	**Ying Ying How - *School of Physics & Astronomy*** Quantifying the x-ray dark-field signal in single-grid imaging
12:00-12:15	**Thomas Aaron Leatham - *School of Physics & Astronomy*** Dark-field propagation-based imaging - a new way of seeing
12:15-12:30	**Arman Pili - *School of Biological Sciences*** Advancing invasion science in silico: developing virToad to forecast the spatiotemporal invasion dynamics and management of a global invader
12:30-12:45	**Andrés Bonilla - *School of Mathematics*** We stand a chance
12:45-13:00	**Juan Carlos Graciosa - *School of Earth, Atmosphere & Environment*** Megathrust Seismicity Through the Lens of Explainable Artificial Intelligence

Oral presentation Session 2 *Session Chairs Bernard Field and Ielyzaveta Ivanova*	
14:00-14:15	**Peter Halat - *School of Chemistry*** Theoretical examination of ionic liquids capable of maintaining long-lived electric fields
14:15-14:30	**Shijia Jin - *School of Mathematics*** Trades and prices: a game-theoretic perspective
14:30-14:45	**Lachlan Gaudin - *School of Chemistry*** A Pseudo Single-Crystal Study of Pt Surface Electrochemistry
14:45-15:00	**Robert Hickingbotham - *School of Mathematics*** Stack-number is not bounded by queue-number
15:00-15:15	**Angus Southwell - *School of Mathematics*** Connectivity of broken networks
15:15-15:17 *Lightning talk*	**Jen How Daryl Lee - *School of Chemistry*** Brown coal-derived carbon materials for water electrolysis
15:17-15:19 *Lightning talk*	**Jaimie-rose Sheil - *School of Physics and Astronomy*** LINERs/LIERs in massive, star-forming galaxies
15:19-15:21 *Lightning talk*	**Kirti Thakur - *School of Chemistry*** Polymeric Adsorbents for PFAS Remediation from Water

Oral presentation Session 3 *Session Chairs Shijia Jin and Lachlan Gaudin*	
12:15-12:30	**Sam Dekkers - *School of Physics and Astronomy*** Searching for New Physics with the COMET Experiment
12:30-12:45	**Adam Kennedy - *School of Chemistry*** Probing the Mechanism of Action using a Metallated Oxytocin Analogue
12:45-1:00 Zoom presentation	**Khe Jia Ming - *School of Science (MUM)*** Encapsulated Silver-NHC complex in Nanofibers: A Strategy Towards a More Efficient and Sustainable Drug Delivery System.
1:00-1:15 Zoom presentation	**Goh Boon Hee - *School of Science (MUM)*** Geraniin as a potential treatment against hypertension

Oral presentation Session 4 *Session Chairs Andrés Bonilla and Peter Halat*	
14:00-14:15	**Aidan Gentle - *School of Mathematics*** A geometric approach to perfect sequence covering arrays
14:15-14:30	**Jake Kotevski - *School of Biological Sciences*** Carnivorous Dinosaurs of Eastern Australia
14:30-14:45	**Ruairidh Duncan - *School of Biological Sciences*** Enigmatic Whales of Non-Analogous Seas
14:45-15:00	**Patrick Davey - *School of Chemistry*** Versatile Phosphonate/Acetate Bifunctional Chelators for Gallium-68 – Synthesis, Radiolabelling and Biomolecular Functionalisation
15:00-15:15 Zoom presentation	**Vani Juliyanti - *School of Science (MUM)*** Investigation of Bacteria and Fungi in The Root of Cultivated and Weedy Rice
15:15-15:30 Zoom presentation	**Nazmul Hasan Muzahid - *School of Science (MUM)*** Genomic and Phenotypic Analysis and Investigation of Virulence of Acinetobacter baumannii Isolated from Community and Hospital: an epidemiological study in Segamat, Malaysia
15:30-15:36 *Zoom poster presentation*	**Rupany Selvam - *School of Science (MUM)*** Aptamers as the new antibacterial agent
15:36-15:41 *Zoom poster presentation*	**MD Mainul Hasan Sarker - *School of Science (MUM)*** Identification of heat-tolerant Malaysian weedy rice and genomic variants study on selected HSPs

Oral presentation Session 5 *Session Chairs Ruairidh Duncan and Patrick Davey*	
10:30-10:45	**Bernard Field - *School of Physics and Astronomy*** Quantum electronics with metal-organic frameworks
10:45-11:00	**Michelle Croughan - *School of Physics and Astronomy*** New X-Ray imaging technique to drive Medical and Industry research
11:00-11:15	**Tahlia Fulton - *School of Biological Sciences*** Diet as Medicine
11:15-11:30	**Joren Van Herck - *School of Chemistry*** Digital Chemistry – Automated Polymer Screening Platform
11:30-11:45	**Siyuan Zhai - *School of Chemistry*** Synthesis and reactivity of mono- and bis-aminoboranes: new twists in the story of hydroboration
11:45-12:00	**Ankita Tulangekar - *School of Biological Sciences*** Unravelling the mechanisms of inflammation-induced muscle damage in Duchenne Muscle Dystrophy
12:00-12:15	**Dashika Palipana - *School of Biological Sciences*** Characterisation of SYNPO2 as a candidate for myopathy

Oral presentation Session 6 *Session Chair Dashika Palipana*	
9:30-9:45	**Anup Kumar Prasad - *School of Chemistry*** Role of an α-helix intermediate in β-sheet Rich Aggregate Formation in Amphibian Antimicrobial Peptide
9:45-10:00	**Ziwen Zhong - *School of Mathematics*** Convergence to Nash Equilibria
10:00-10:15	**Edirimuni Iyomali Abeysekera - *School of Chemistry*** Exploring the synthesis and characteristics of discrete oligo (meth)acrylates via a combined SUMI-Click strategy

Keynote Speakers

Associate Professor Jen Martin

Associate Professor in Science Communication, Biosciences
University of Melbourne

A/Prof. Jen Martin (@scidocmartin) worked as a field ecologist before founding the University of Melbourne's Science Communication Teaching Program which teaches scientists across all disciplines to be engaging and effective communicators. She also practises what she preaches: she's been talking about science weekly on 3RRR, Australia's largest community radio station, for more than 15 years, hosts podcasts, MCs events, teaches as part of the Homeward Bound Faculty, writes for a variety of publications and was named the 2019 Unsung Hero of Australian Science Communication.

Professor Neville Nicholls

Emeritus Professor in the School of Earth, Atmosphere and Environment
Monash University

Professor Neville Nicholls spent 35 years in climate research in the Bureau of Meteorology before joining Monash University in 2006 where he is a Professor Emeritus in the School of Earth, Atmosphere and Environment. He has published over 130 papers in peer-reviewed scientific journals, on the nature, causes, predictability and impacts of Australian and global climate variations and changes. Neville is a past President of the Australian Meteorological and Oceanographic Society, and was an editor of the journal Wiley Interdisciplinary Reviews: Climate Change, and of the American Meteorological Society's Journal of Climate. He was a Coordinating Lead Author for the Intergovernmental Panel on Climate Change (IPCC) Special Report "Managing the risks of extreme events and disasters to advance climate change adaptation" that was completed in 2011.

Workshop 1 - How to Write for The Conversation

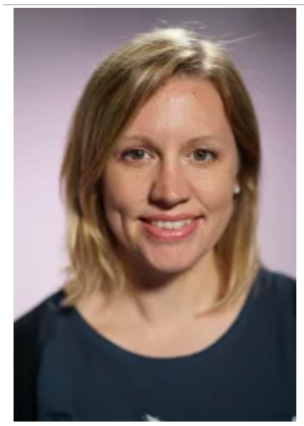
Have you always wanted to try your hand at writing a non-scientific article about your research?

A panel of Faculty of Science academics who write for 'The Conversation' will join Silvia Dropulich (Manager, Marketing, Media and Communications for the Faculty of Science), to speak about:

- The importance of communicating research and the impact it has
- How to know if your research is worth communicating
- How to pitch for the desired audience
- Who to contact for help

Panel members

A/Prof. Alistair Evans
Sch of Biological Sciences



Dr Ailie Gallant
Sch of Earth, Atmosphere & Environment

Prof. Michael Brown
Sch of Physics & Astronomy

Ms Silvia Dropulich
Manager, Marketing, Media, and Communications
Faculty of Science

Workshop 2 - Understanding Research Impact

Are you confused about what 'impact' means, or find it hard to directly link your research to impact?

Dr Tamika Heiden from 'The Research Impact Academy' will guide workshop attendees through:

- Understanding the definitions and terminology around non-academic impacts
- Learning about the different categories of impact and how to achieve them in the different fields of research
- Knowing the pathway to create impact and the elements of successful impact
- Understanding impact activities and how they relate to the impact types
- Learning about impact indicators and the evidence required to support impact claims

To attend this workshop you must have registered for this specific workshop.

Dr Tamika Heiden is the Principal of the Research Impact Academy. She has more than a decade of career experience as a researcher and research manager in the fields of health, sport and medical research that began with a sports science degree and a PhD in Biomechanics. She has a certification in Knowledge Translation from the University of Toronto, and from the International School on Research Impact. Tamika is an honorary research fellow at the Murdoch Children's Research Institute in Victoria, an Adjunct Research Fellow at the University of Western Australia, sits on the scientific committee for the Medical Research Foundation at Royal Perth Hospital, and has a formal partnership with SickKids Hospital in Toronto.

Tamika's national and international work brings together researchers and research users to share, create and translate knowledge for the betterment of society. She has worked with many government and non-government organisations to facilitate high-level overviews and strategic thinking, particularly relevant to the Australian research funding landscape where she gave evidence to the Senate Committee inquiry for the Medical Research Future Fund.

Tamika won the 2018 award for Excellence in Knowledge Translation from the SickKids Learning Institute in Toronto and the Award for Innovation from the Institute for Knowledge Mobilization. Tamika has shared her knowledge with a variety of audiences at conferences and symposiums, run workshops, been published in numerous professional and academic journals, and been involved in the development of Knowledge Translation strategies at the organisational and project levels.

Alumni Panel Session

Hear from previous Graduate Research students about their careers and how they feel their science and career has been impactful.

A diverse group of our esteemed alums will talk about their careers, the impact they believe their science has had and how they created that impact.

Panel members

Dr Zahra Islam
Alumnus - School of Biological Sciences
Research Fellow (Plant-Soil Microbiomes) - University of Melbourne

Dr James Cavallo
Alumnus - School of Mathematics
Quantitative Risk Analyst, Energy Trading - Energy Australia

Dr Anita D'Angelo
Alumnus - School of Chemistry
Beamline Scientist - Australian Synchrotron

Faculty of Science 3 Minute Thesis (3MT)

The 3MT Three Minute Thesis is a competition held annually at every Australian university where Graduate Research students have the opportunity to present their thesis… in only 3 minutes!!

Along with the fun, excitement and challenge of the 3MT, contestants gain invaluable skills in demonstrating the importance and impact of their research to a wide audience.

The Faculty Finalist and Runner-up will be determined by an expert judging panel:

- Mr Angus Rogers – 2021 Faculty of Science 3MT Winner, PhD Candidate, School of Earth, Atmosphere and Environment
- Dr Gary Beane – Faculty Early Career Researcher Representative, School of Physics and Astronomy
- Dr Sara Kyne – Senior Lecturer, School of Chemistry

The MC of the competition will be A/Prof. Ricardo Ruiz Baier (Graduate Research Coordinator, School of Mathematics)

The People's Choice will be determined by YOU!!! Please bring your smartphone or internet-enabled device for voting.

Faculty Competition Prizes:

- Faculty of Science 3MT Finalist - 1st Prize - $300 Coles Group & Myer gift card + entry into the Monash 3MT Finals
- Faculty of Science 3MT Runner Up - 2nd Prize - $200 Coles Group & Myer gift card + entry into the Monash 3MT Wildcard Competition
- Faculty of Science 3MT People's Choice (Sponsored by Monash Graduate Association (MGA)) – $50 eGift Card
- Door Prizes

Presentation Impact Statements

Are traditional classes of drought appropriate to describe water shortages that affect agriculture in Bangladesh?
MD Anarul Haque Mondol - School of Earth, Atmosphere and Environment

In this research, we argue that the traditional classes of drought cannot adequately decipher areas that are drought-impacted through technological failure alone, nor can they be used to examine the extent of drought impacts that are due to failures of water management and irrigation technology. Over the years, people have used traditional irrigation methods and lack modern irrigation infrastructure, which hampers the agricultural water demand. To account for these types of water scarcity and agricultural water shortages, we introduce the concept of technological drought. This research is well aligned with the UN sustainable development goal.

The Communication Gap in Climate Change Education
Matt Carew - School of Biological Sciences

This presentation, based on my PhD research project, is directly aligned with UN SDG 4 (Quality Education). My research is investigating how climate change communication skills are being taught at Australian universities. Climate change is an intensely complex, multi-faceted issue, and equipping students with the skills to effectively communicate climate change in a range of contexts, industries and communities will be crucial to addressing this problem. Based on my initial research, these skills appear to be under-prioritised in universities - my research aims to find out why, and how this could be changed for the better.

The role of Australia's protected areas in supporting biodiversity
Ielyzaveta Ivanova - School of Biological Sciences

Protected areas, such as national parks and reserves, aim to preserve declining biodiversity. Sometimes they are not successful in slowing or stopping decline. One key reason for failure is incorrect design – the protected area was too small or isolated to support the intended biodiversity long term. My work seeks to understand the capacity of the current protected area network in Australia to achieve long term conservation outcomes for a range of native mammals. Knowing what makes protected areas successful is critical in making the most of our limited time to act.

Quantifying the x-ray dark-field signal in single-grid imaging
Ying Ying How - School of Physics and Astronomy

One of the challenges in building thriving communities is effective healthcare. This project aims to use fundamental research to develop new methods of x-ray imaging that can advance treatment through biomedical research projects, and ultimately become a new diagnostic tool in hospitals. We aim to see microstructures that are inaccessible from conventional x-ray imaging, via a dark-field signal, generated by scattering from these microstructures. My novel methods quantify the microstructures properties without fully resolving those structures. This is achieved by projecting a reference pattern on the sample and measuring subtle blurring effects due to this scatter.

Dark-field propagation-based imaging - a new way of seeing
Thomas Aaron Leatham - School of Physics and Astronomy

Emerging x-ray imaging methods are tapping into a new wealth of sample information through accessing the 'dark-field' signal, allowing us to visualise previously unseen sample features, such as the air sacs in the lungs, and small cracks in industrial parts. We present a novel approach to accessing the dark-field signal using an experimental setup, whose application will help with addressing medical, security and industrial challenges on a global scale, ensuring that we, as a society, can continue to seek and live the 'good life'. We believe our approach will pave a new era in x-ray imaging technology, helping communities thrive.

Advancing invasion science in silico: developing virToad to forecast the spatiotemporal invasion dynamics and management of a global invader
Arman Pili - School of Biological Sciences

Invasive alien species are non-native species whose invasions wreak ecological havoc that costs world countries hundreds of billions annually in economic losses. One of the most significantly impactful and well-studied global invaders is the cane toad (Rhinella marina). I curated cane toad literature and developed virToad — a hyper-realistic life-history simulator of the cane toad. virToad can be used by researchers and practitioners to understand and forecast the cane toad's spatiotemporal invasion dynamics and explore, optimize, and prioritize cane toad on-the-ground management responses. virToad sets the next era of fundamental and applied research on cane toad invasion and management.

We stand a chance
Andres Bonilla - School of Mathematics

A brief glance into the history of dynamical systems, how they developed into tools we use today, how they helped us understand our universe, and the current state of the field.

Megathrust Seismicity Through the Lens of Explainable Artificial Intelligence
Juan Carlos Graciosa - School of Earth, Atmosphere and Environment

Understanding the controls on large magnitude seismicity occurrence remains an open challenge for the exceptional hazard associated with earthquakes. Different parameters are proposed to exert control on the generation and propagation of megathrust earthquakes and untangling their complex interactions across scales remains challenging. Although powerful, neural networks and their results are hard to interpret and are usually treated as a blackbox. This downside has limited its use in scientific disciplines where the interpretability of results is of great importance. Here, we use interpretable machine learning to provide relevant constraints on the parameters that dominate the seismicity in a region.

Theoretical examination of ionic liquids capable of maintaining long-lived electric fields

Peter Halat - School of Chemistry

This work uses theoretical simulations to examine and predict the sustained electric fields exhibited by Ionic liquids. Ionic liquids are non-volatile, recyclable, customisable solvents used to 'greenify' chemical processes. Any research into the possible uses of ionic liquids is a foray into sustainable research, with this work specifically impacting energy storage. The ability to design theoretical frameworks to complement and predict experimental results improves our fundamental knowledge of the chemistry of ionic liquids. In pursuing the behaviour of these compounds at a molecular level, a greater understanding of the building blocks of our universe is attained.

Trades and prices: a game-theoretic perspective

Shijia Jin - School of Mathematics

Trades impact prices. Problems on the trading side (known as optimal executions) and the pricing side (called market making) have been studied extensively but separately. The strategic interactions between these two parties are left unknown. How will these two sides react to each other? Should they be cooperative or disobliging? We hope such game-theoretic views will bring new insights on how tradings can be conducted to fulfill the need, and how price can be determined as a response, while forming a cooperative and sustainable platform. Mathematically, techniques in solving arising differential equations may invite new ideas in the general field.

A Pseudo Single-Crystal Study of Pt Surface Electrochemistry

Lachlan Gaudin - School of Chemistry

Humankind, in the modern era, is faced with many existential threats, with one seen to be front and centre: climate change. Accelerated by our industrialism, we are now in part relying on our technological advances to secure a sustainable future on Earth. To achieve this, many advances are seen to be crucial, especially in the area of energy. My work involves the fundamental analysis of materials and their electrochemistry. By developing our fundamental understanding of how nanomaterials (becoming ubiquitous in modern technology) affect the performance of fuel cells and electrolysers, we hope to make an impact on our future.

Stack-number is not bounded by queue-number
Robert Hickingbotham - School of Mathematics

Stacks and queues are fundamental data structures in computer science, but which is more powerful? In 1992, Heath, Leighton and Rosenberg introduced an approach for answering this question by defining the graph parameters stack-number and queue-number, which respectively measure the power of stacks and queues for representing graphs. Applications of these parameters include computational complexity, RNA folding, graph drawing in two and three dimensions, and fault-tolerant multiprocessing. In this talk, I will present a graph family with queue-number at most 4 and unbounded stack-number. This implies that stacks are not more powerful than queues for representing graphs.

Connectivity of broken networks
Angus Southwell - School of Mathematics

Whether a network (or graph, in maths terminology) is connected is a fundamental property which impacts all sorts of other properties and results about that network. In my PhD I have been studying the thresholds at which networks stay connected, or at least have a large connected component, even when many nodes are deleted. I do this by studying what are known as random graphs, which are graphs generated according to some probability distribution.

Brown coal-derived carbon materials for water electrolysis
Jen How Daryl Lee - School of Chemistry

While renewable energy sources (e.g. solar and wind) are free of direct CO2 emissions, their intermittency and supply-generation discrepancies can hinder their adoption. Energy storage solutions allow storage of the electricity generated so that it can be utilised upon demand. Among these storage technologies is green hydrogen, produced from water electrolysis. As of now, high material costs are involved, so research efforts are directed to develop cheap and effective materials for green hydrogen production. My research involves the synthesis and characterisation of carbon-based materials for this application.

LINERs/LIERs in massive, star-forming galaxies
Jaimie-rose Sheil - School of Physics and Astronomy

Typically, very massive galaxies are passive, however there are exceptions which can help us understand galaxy evolution. We have compiled a sample of 127, massive, star-forming, local galaxies to see how they differ from comparable mass, passive galaxies by studying their spectra. We have found that 73% of our sample are LINERs/LIERs, far beyond the expected 30% in typical massive galaxy populations. These results indicate that LINER/LIER emission in massive galaxies may be linked to the presence of cold gas and star formation and hence allows us to better understand galaxy evolution, star-formation quenching and our changing universe.

Polymeric Adsorbents for PFAS Remediation from Water

Kirti Thakur - School of Chemistry

Increasing industrialisation and chemical use have polluted water streams and tackling persistent pollutants is economically non-viable owing to high energy and resource intensive remediation technologies. PFAS (perfluoroalkyl substances) are water, fire and chemical resistant man made pollutants causing endocrine disruptions, changes to foetal development and is a known carcinogenic. Mechanically robust, high capacity polymer adsorbents are being developed for remediation of acidic PFAS compounds. An understanding of fundamentals of PFAS interactions with polymers in different environmental conditions using computational methods is also being studied. The current research focusses on finding biopolymers that adsorb PFAS and provide a green alternative.

Searching for New Physics with the COMET Experiment

Sam Dekkers - School of Physics and Astronomy

The Standard Model is our best theory describing our Universe's fundamental particles and interactions but it is incomplete. For example, numerous tensions have been recently observed such as the latest W boson mass measurement. As evidence begins to mount for potential new physics it becomes clear that we could be entering a new paradigm of fundamental physics research and experiments probing beyond the Standard Model bring us closer to better understanding our Universe. One such experiment that Monash University is helping realise is the COMET experiment which is searching for charged lepton flavour violation, a clear signature of new physics.

Probing the Mechanism of Action using a Metallated Oxytocin Analogue

Adam Kennedy - School of Chemistry

Oxytocin is used to induce labour, prevent postpartum haemorrhage, and is involved in social bonding and mental health disorders centred within the central nervous system. Many analogues of oxytocin have been developed over decades of research, but have been hampered by a poor understanding of the mechanism of action at a molecular level. In this research project, we examine novel metallated oxytocin analogues which show improved biological activity and help improve clarity on how oxytocin works in the body. This will help improve development of new drugs and treatments which treat oxytocin-related issues, including mental health disorders.

Encapsulated Silver-NHC complex in Nanofibers: a strategy towards a more efficient and sustainable drug delivery system

Khe Jia Ming - School of Science

Widely used antimicrobials such as silver nitrate and sulfadiazine have been known to kill bacteria quickly. However, their antibacterial effect fades shortly, rendering possible emergence of antimicrobial resistance. We have recently synthesized a few new silver N-heterocyclic carbene (NHC) complexes and evaluated their antimicrobial properties. Our study showed that the silver-NHC complexes possess promising antimicrobial activities, with minimum inhibitory concentration (MIC) against microbes ranging from 0.24 to 7.81 μg/mL. The most potent silver-NHC complexes will then be electrospun into nanofibers to prolong their bioactivities and improve drug delivery to the target sites, potentially preventing overdosage and overcoming antimicrobial resistance.

Geraniin as a potential treatment against hypertension

Goh Boon Hee - School of Science

Hypertension (high blood pressure) affects nearly 1.4 billion of the world population, and is a key contributor towards cardiovascular diseases. Our group had previously reported that geraniin, an ellagitannin isolated from the rinds of Nephelium lappaceum (rambutan, a common Southeast Asian fruit), effectively reduced blood pressure in diet-induced obese rats. Therefore, this project aims to decipher the anti-hypertensive mechanism of geraniin. Our research project fits perfectly to the Goal 3 of Good Health and Well-Being under UN Sustainability Goals, specifically the Target 3.4. Our research findings will showcase geraniin as a potential natural treatment and/or non-medicative way to manage hypertension.

A geometric approach to perfect sequence covering arrays

Aidan Gentle - School of Mathematics

Perfect sequence covering arrays are sets of sequences of n numbers such that every sequence of k of these numbers appears as a subsequence of a fixed number of sequences in the set. These objects are used to design testing schemes for software systems in which the improper ordering of processes can lead to system faults. In constructing these objects, I have developed innovative methods that draw on multiple areas of mathematics including combinatorics, geometry, and group theory. This has led to new analysis of several geometric objects.

Carnivorous Dinosaurs of Eastern Australia

Jake Kotevski - School of Biological Sciences

Palaeontology is perhaps most famous for the study and description of the dinosaurs. Understanding the dinosaurs has been essential in developing theories of evolution, plate tectonics and biogeography. In the past, Australian dinosaurs have been described with ‘Laurasian goggles’ and ascribed to clades from the northern hemisphere; in actuality, many of these specimens share significant affinities with Gondwanan groups. In this project, I aim to redescribe the Australian theropod dinosaur fauna, and revise the phylogeny of one of the most enigmatic dinosaur clades, the Megaraptora, using detailed CT scanning, comparative anatomy, and phylogenetic testing.

Enigmatic Whales of Non-Analogous Seas

Ruairidh Duncan - School of Biological Sciences

The return of air-breathing tetrapods to the marine realm is an infrequent but pivotal event occurring a handful of times in life’s history. Whales have been immensely successful in this transition, and the analysis of this phenomenon has been essential to our understanding of the adaptability of life on Earth. One of the puzzles that remain is the transition from ancient whales to the baleen whales, who use their immense skulls to strain vast quantities of prey from the world’s oceans. This project aims to clarify how the last toothed baleen whales fit into the story of whale evolution.

Versatile Phosphonate/Acetate Bifunctional Chelators for Gallium-68 – Synthesis, Radiolabelling and Biomolecular Functionalisation

Patrick Davey - School of Chemistry

Positron emission tomography (PET) is a molecular imaging technique that produces high resolution 3D images used to diagnose and monitor the progression of disease. Gallium-68 (t1/2 = 68 min) is a positron-emitting metallic radionuclide that is used in PET to radiolabel biomolecules with affinity and selectivity for receptors associated with disease. To apply metallic radioisotopes to biological applications, chelators can be used that form complexes with high thermodynamic stability and kinetic inertness to avoid dissociation and hydrolysis of the radiometal. In a continuing effort to utilize these chelators for radiopharmaceutical applications, we have synthesized new bifunctional derivatives (NO3A-Lys and NOA2P-Lys) and investigated their 68Ga3+ radiolabelling properties.

Investigation of Bacteria and Fungi in The Root of Cultivated and Weedy Rice

Vani Juliyanti - School of Science

Weedy rice has become one of the major weed problems in many paddy fields around the world resulting in massive loss. On the other hand, the production of rice crop has to increase to cope with the world's growing population. The eradication process of this weedy rice is very challenging due to its high similarity to the cultivated rice. Therefore, exploring the microorganisms inside the root of cultivated and weedy rice may help to shed light on the beneficial microorganisms that could potentially help weed control or for better plant growth.

Genomic and Phenotypic Analysis and Investigation of Virulence of Acinetobacter baumannii Isolated from Community and Hospital: an epidemiological study in Segamat, Malaysia

Nazmul Hasan Muzahid - School of Science

This study focuses on Acinetobacter baumannii which is a frequent cause of multidrug-resistant nosocomial infections worldwide. The World Health Organization regards such A. baumannii as the gravest bacterial threat to global public health. We are investigating the role of the community as a potential reservoir of pathogenic A. baumannii by comparing isolates from the community in Segamat District, Malaysia with those isolated from patients in the local government hospital. Our data demonstrates a close relationship and pathogenic nature between some isolates from the community and hospital and suggests that there might be inter-changeable membership of the two groups.

Aptamers as the new antibacterial agent

Rupany Selvam - School of Science

Antibiotic resistance increases the rate of morbidity and mortality as the diseases become difficult to treat. Pseudomonas aeruginosa represents one of the most concerning pathogens involved in antibiotic resistance where the World Health Organization has classified this gram-negative bacterium as ESKAPE organism and it is also listed in the Priority 1: Critical list. Hence, in this project, we propose a novel intervention using aptamers to recognize and inhibit the growth of Pseudomonas aeruginosa. Due to the long timeline and high cost in antibiotic production, we are focusing on aptamers that have the same

purpose as antibiotics but cost effective and shorter production timeline. This research will provide new insights into the development of new antimicrobial agents.

Identification of heat-tolerant Malaysian weedy rice and genomic variants study on selected HSPs

Md Mainul Hasan Sarker - School of Science

Despite its ability to sustain difficult conditions, the genetic origin of weedy rice remains a mystery. The current state of the climate is now a severe global threat. Climate change is one of the many threats rice faces during its life cycle, which includes biotic and abiotic difficulties. The production of heat-resistant crops is currently in high demand. Existing heat-tolerant crop changes aren't enough to keep production high, therefore new ways are being sought. It was revealed that nine of the 180 weedy rice accessions studied were heat-tolerant (MU235, MU244, MU022, MU260, MU237, MU263, MU249, MU052, and MU066). Experimenters tested five heat-sensitive (HS) and five heat-tolerant (HT) accessions for their relative electrical conductivity (REC) and oxidative stress. The five alleged HT accessions outperformed the HS samples in every single test. HS (MU100, MU114, MU022, and MU005) and HT (MU060, MU235, and MU237) WGSs were used for the genome-wide study. A total of 357 and 329 nsSNPs were found in HT and HS, mostly located in 57 HTRG genes, by in silico variant identification. Both small heat shock proteins (HSPs) and a heat shock transcription factor are unique to HT (HSP18 and HSFA2E). It was shown that only two HSPs (HSP17.7 and HSP101) occurred beneficial mutations in HS and six HSPs (HSP16.9B, SIZ1, ANN2, HSFB1, HSFB2C, and HSFA2C) in HT. Over-expression of those six HTRGs functional act to tolerate the heat stress.

Quantum electronics with metal-organic frameworks

Bernard Field - School of Physics & Astronomy

Metal-organic frameworks are extremely versatile materials. Some can host strong interactions between electrons. These interactions cause exotic electronic phases, like Mott insulators and superconductivity, which can be used for next-generation energy-efficient electronics. My research has investigated strong electronic interactions in two-dimensional metal-organic frameworks. I have uncovered how building these frameworks on bulk materials affects their properties, which is vital knowledge for creating practical devices. I have also shown how these materials can be switched between interacting and non-interacting phases, which is a key step for designing novel electronics.

New X-Ray imaging technique to drive Medical and Industry research

Michelle Croughan - School of Physics & Astronomy

My PhD focuses on a novel X-ray imaging technique that will allow new R&D in multiple fields of medicine and industry. Currently most x-ray imaging relies solely on attenuation (how much the x-rays are absorbed), but there are other properties we can also measure that tell us more about the patient or object we take an image of. But by developing ways to measure different x-ray properties we can collect information that was not previously possible.

Diet as Medicine

Tahlia Fulton - School of Biological Sciences

Everyone needs to eat, and nutrition affects many aspects of our health. Protein and amino acid intake drive many physiological responses to diet, such as ageing, reproduction and resilience. In animal models for example, removing a single dietary amino acid can prime the animal to better tolerate physical stress, such as surgery or poison. I use Drosophila to characterise the relationship between cellular sensors of amino acids and enhanced toxin resistance following deprivation of an essential amino acid. Understanding how nutrition can increase stress tolerance could lead to real world applications such as diets that improve recovery of clinical patients.

Digital Chemistry – Automated Polymer Screening Platform

Joren Van Herck - School of Chemistry

Industry 4.0 has found its way into chemical research. The use of computers and advanced algorithms is becoming integrated in the day-to-day life of a chemist. Innovations in reactor design, analytic devices and software is changing the way chemistry is done. This is particularly true for high-throughput screening/experimentation, where traditional protocols are inherently time consuming and cost-ineffective. The automatization and digitalization of chemistry can facilitate and drastically speed up such tasks. We present an automated platform for rapid kinetic polymerization screenings. In less than 2 hours, a full kinetic profile based on more than 250 single data points can be obtained.

Synthesis and reactivity of mono- and bis-aminoboranes: new twists in the story of hydroboration

Siyuan Zhai - School of Chemistry

Mono- and bis-aminoboranes are scarcely used as reducing and hydroboration reagents in organic reactions. While mono-aminoboranes are reasonably well studied as regents in several transformations, bis-aminoboranes are relatively unknown to the scientific community owing to the underdeveloped methods for their synthesis and purification. Here we propose a completely new synthetic method based on controlled hydroboration of imines resulting in a simple and clean approach for the synthesis of both mono- and bis-aminoboranes. Meanwhile, we also discuss different reaction mechanisms between three-coordinate (bis-aminoboranes) and four-coordinate boranes (dimeric mono-aminoboranes)4, with respect to reduction of carbonyl species.

Unravelling the mechanisms of inflammation-induced muscle damage in Duchenne Muscle Dystrophy

Ankita Tulangekar - School of Biological Sciences

Duchenne Muscular Dystrophy (DMD) is a neuromuscular disorder caused by mutations in the dystrophin gene and is characterised by early demise of an individual. Role of inflammation and oxidative stress in exacerbating muscle damage is not completely understood. Using a dmd zebrafish model we have shown that inflammatory and cell death markers are transcriptionally upregulated in the early stages of DMD. Our studies also show that muscle function is improved in dmd zebrafish in the absence of myeloperoxidase (MPO), an enzyme synthesised by neutrophils. These studies will help us understand the key pathological factors which promote muscle damage in DMD

Characterisation of SYNPO2 as a candidate for myopathy
Siddiyanuge Dashika Sandeepani Palipana - School of Biological Sciences

Myopathies are a group of inherited diseases that are characterised by muscle damage. Worldwide prevalence of these diseases is about 14%. Due to the large number of unidentified myopathy genes, about 50% of myopathy patients are left without a genetic diagnosis. Due to its enrichment in muscle I have chosen to evaluate SYNPO2 as a candidate myopathy gene. My results show that loss of Synpo2 in zebrafish leads to damaged muscle fibres under mechanical stress and impaired macroautophagy. Adding SYNPO2 to the genetic diagnostics panel for myopathy will help to provide a genetic diagnosis to the patients.

Role of an α-helix intermediate in β-sheet Rich Aggregate Formation in Amphibian Antimicrobial Peptide
Anup Kumar Prasad - School of Biological Sciences

The research is about the role of helical intermediate in beta-sheet aggregation. Uperin peptide is an antimicrobial peptide that form amyloid in saline solutions. The amyloid formation is associated with Alzheimer's, Parkinson's, etc. neurodegenerative diseases. The research highlights the mechanism of beta-sheet rich aggregation with the help of helical intermediates.

Convergence to Nash Equilibria
Ziwen Zhong - School of Mathematics

We study a random walk on a randomly oriented hypercube. Our results can be applied to establish the convergence of Best-Response Dynamics (BRD) to Pure Nash Equilibria (PNE) in random games. These games are characterised by N players. Each player can choose among two actions. The payoffs are assumed to be random and i.i.d. The impact of our research is to show the strict relation between random games and percolation theory, where the theory has become very important in both the mathematics and physics communities. Moreover, we provide analytic results rather than simulations.

Exploring the synthesis and characteristics of discrete oligo (meth)acrylates via a combined SUMI-Click strategy
Edirimuni Iyomali Abeysekera - School of Chemistry

The chain length of a polymer can vary from two monomers to practically infinite number of monomers and dispersity is crucial in determining the overall polymer properties such as viscosity, diffusion, thermal properties and self-assembly. A uniform (monodisperse) polymer made with exact chain length is vital for mimicking biopolymers with well-defined structures and complex functionalities. Synthesis of monodisperse polymers is, however, highly challenging due to the inherent statistical nature of radical polymerizations. Controlled radical polymerization coupled with flash chromatographic separation provides a promising approach for fabricating monodisperse short oligomers. Achieving high chain lengths by these methods are highly tedious and to reach chain length above a degree of polymerization of 10 click chemistry approaches are being considered.

Poster Impact Statements

Minisci-type Alkylation Mediated by EDA Complex and Blue LED Light

Jiacheng Li - School of Chemistry

The synthetic utility of the C-C bond formation reaction has often been hampered by the need for excess amounts of the oxidant, transition metal, strongly acidic conditions and high reaction temperature. We are providing a metal-free synthetic protocol to form a new C-C bond under Blue LED light condition, at room temperature. These mild reaction conditions provide us a totally new methodology to form new bond.

Gold catalysed counteranion directed chemoselective asymmetric synthesis of pyrroles and 1,8-dihydroindeno[2,1-b]pyrroles

Lorenzo Carli - School of Chemistry

The asymmetric synthesis of chiral molecules is one of the main pillars of modern synthetic organic chemistry. The design of catalytic approaches for this goal is most desirable economically and environmentally and transition metal catalysis has revealed itself to be a powerful and versatile tool to achieve this goal. Here we present a convenient gold(I)-catalysed methodology to convert propargyl alcohols to either pyrroles or condensed indanes in up to 96% yield and 98% ee. The strategy deployed uncovers a ground-breaking counteranion operated tuning of catalytical reactivity.

Chiral Gold Catalysed Cycloisomerisation/Regio and Enantioselective Nitroso-Diels Alder Reaction of 1,6-Diyne Esters with Nitrosobenzenes

Anyawan Tapdara - School of Chemistry

This work is about discovering the synthetic method to generate chiral substituent N,O heterocyclic which is the important core of some natural or biological products.

Rhodium Catalysed Cycloisomerisation/6π Electrocyclisation of 5-(Ethynylamino)pent-2-yn-1-yl Esters to Partially Hydrogenated benzo[f]indoles

James Merrett - School of Chemistry

Rhodium-catalysed cycloisomerisations of propargylic esters is a very powerful and efficient strategy to construct molecular complexity from easily accessible starting materials using mild conditions. Diynes are a common substrate used in rhodium catalysis due to their predictable and reliable reactivity. Herein we present the synthesis of 2,3-dihydrobenzo[f]indole derivatives that proceed through a rhodium-catalysed cycloisomerisation/6π-electrocyclisation of 5-(ethynylamino)pent-2-yn-1-yl esters. The reaction is suggested to proceed through formation of a rhodacyclopentadiene followed by de-esterification to generate a rhodium-carbenoid. Re-esterification at the carbenoid carbon centre of the organorhodium-complex triggers a reductive elimination of the rhodium, forming an allene-ene which undergoes 6π-electrocyclisation to give 2,3-dihydrobenzo[f]indoles.

Gold-Catalysed Chemoselective Michael–Type Addition of 1H-Indoles to Diazoquinones

Andres Felipe Leon Rojas - School of Chemistry

Gold catalysis has emerged over the last two decades as an unparalleled tool for the development of novel synthetic strategies. In the realm of diazo compounds, gold-mediated transformations commonly proceed via dinitrogen extrusion providing a gold carbenoid species which can subsequently engage in carbene and/or cationic chemistry. However, reactions involving the preservation of the diazo moiety are much more limited, but are of equal interest as a powerful means to assemble C–N linkage. Here we disclose a chemoselective method to prepare 3-arylazoindoles from gold(I)-catalysed 1,4-addition of 1H-indoles to diazoquinones, compounds of potential interest in material science.

Membrane solubilisation by tuneable polymer nanodiscs

Michelle Dionne Farrelly - School of Chemistry

Membrane proteins reside within the phospholipid bilayers compartmentalising cells and organelles and are instrumental to the functioning and ultimately to the survival of organisms. Although membrane proteins have significant biological consequences making them predominant targets for drugs, their structures are underrepresented in the protein database due to inherent difficulties involved in their extraction and biophysical characterisation. This is where my research into developing novel synthetic polymer nanodiscs, structures which directly incapsulate functional membrane proteins and surrounding phospholipids into water soluble discs, offers an analytical tool to access knowledge about the elusive structures of membrane proteins.

Modelling Non-Newtonian Thin Film Evolution between Bubbles and Surfaces

Benjamin Jacob Lee - School of Mathematics

When a bubble in a liquid approaches a surface, a thin film forms in the gap. Understanding the evolution of this film is important in industrial applications. Having a reliable model to predict film evolution helps to design and optimise processes in these applications. The fluids involved may be non-Newtonian, having more complex flow behaviour compared to Newtonian fluids. A reliable model exists for Newtonian fluids, but not for non-Newtonian fluids. My research aims to extend this model to non-Newtonian fluids to explore how the film evolution changes.

Understanding the physics of the largest earthquakes

Thyagarajulu Gollapalli - School of Earth, Atmosphere and Environment

Earthquakes with a magnitude more than or equal to 8.0 (Mw >= 8.0) are known as great earthquakes. The energy released from these earthquakes is incredibly enormous and they are similar to a few trillion kilograms of explosives. Within the past two decades, we have already witnessed two such great earthquakes, e.g., the Sumatra 2004 Mw 9.2 on boxing day and the Tohoku 2011 Mw 9.0. These two earthquakes have claimed nearly half a million human lives and triggered economic damage of > $360 billion. In my PhD, I created advanced numerical modelling techniques to understand the physics of such events and to advance our current seismic hazard knowledge.

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