Monash University Faculty of Science ARC-Funded Projects

ARC Discovery Early Career Researcher Award (DECRA) for funding commencing in 2018 (DE18)

Awarded Grants - Details

Project ID	Investigator(s)	Summary	Funding Awarded	School
DE180100854	Dr Carly Cook	An evidence-based approach to integrate evolutionary theory in conservation. This project aims to integrate evolutionary theory into conservation science to ensure management promotes the long-term resilience of biodiversity. The management of evolutionary risks and benefits is routinely left out of decision tools that identify optimal management strategies. By developing tools that integrate evolutionary theory into key conservation problems, this project is expected to significantly advance conservation science. It should provide managers with essential tools to support the persistence of biodiversity and thus long-term success of biodiversity conservation.	$356,761.00	Biological Sciences
DE180101164	Dr Akane Uesugi	Evolution of chemical warfare in invasive plants. The project aims to test when, where and how exotic plant populations become invasive through the rapid evolution of chemical compounds that inhibit native plant species. Using an innovative quantitative genetics framework, the intended outcome is to determine how the chemicals are selected, and whether there is sufficient heritable variation for the chemicals to evolve across heterogeneous landscapes characteristic of introduced ranges. The project will deliver key insights into the ecological and genetic mechanisms of adaptive evolution in invasive species, and predict evolutionary dynamics of biological invasions that inform their effective management. The project's expected outcomes will be useful to policy makers, weed managers and farming communities.	$365,058.00	Biological Sciences
DE180101558	Dr Matthew McGee	The biodiversity consequences of evolutionary innovation. This project aims to increase knowledge of how evolutionary innovations affect biodiversity. This project will focus on a classic example of evolutionary innovation, the specialized throat jaws found in many fish groups, including damselfishes, wrasses, and cichlids. These unique jaws may explain why these fish groups contain so many species and are such successful invasive species in Australia and elsewhere. This project proposes an integrative combination of methods and functional experiments to reveal the biodiversity consequences of evolutionary innovation. It will also enhance Australian biosecurity through the production of new ways to assess invasion risk from aquaculture and aquarium trade species.	$365,058.00	Biological Sciences
DE180100215	Dr Rouhollah Jalili	Nature-inspired electrochemical conversion of nitrogen to ammonia. This project aims to achieve a highly active electrochemical catalytic system for ammonia production from atmospheric nitrogen under ambient conditions. Ammonia is essential for plant growth and food production but its synthesis is energy intensive, eco-destructive and costly. The project will design a functional device featuring a catalyst that will not only provide insights into the fundamentals of nitrogen reduction but also a sustainable and cost effective production of ammonia, a potential key to future world food supply and renewable energy.	$368,446.00	Chemistry
DE180100781	Dr Shimpei Endo	Strong few-body correlations from controllable impurities in quantum matter. This project aims to investigate the role of few-body correlations in quantum matter by using recently developed theoretical approaches to incorporate correlations beyond the scope of traditional theories. The project expects to gain fundamental insight into quantum few-body correlations in materials by investigating single impurity particles immersed in quantum media, such as	$343,450.00	Physics and Astronomy

highly controllable atomic gases and semiconductors. The significant benefits include the development of novel theoretical approaches and the generation of knowledge that could potentially underpin a new generation of quantum devices.

ARC Discovery Project for funding commencing in 2018 (DP18)
Awarded Grants - Details

A. Awarded grants - administered through Faculty of Science

Project ID	Investigator(s)	Summary	Funding Awarded	School
DP180103925	Professor Craig White; Dr Lesley Alton	The evolution of biological scaling. This project aims to understand why so few biological traits scale proportionally with body size. In contrast to previous mechanistic studies of this longstanding question, the problem will be approached from an evolutionary viewpoint, using artificial selection to engineer animals in which biological scaling laws are either broken or enhanced. By measuring the consequences of this for fitness, the project will provide a new understanding of how organismal size and physiology evolve in nature. The approach should provide significant benefits to our understanding of the role of genetic constraints in hindering or facilitating biological adaptation, furthering our understanding of the capacity of animals to respond to environmental change.	$379,489.00	Biological Sciences
DP180102359	Professor Paul Sunnucks; Dr Antoine Stier; Professor Steven Beissinger	Can mitochondrial and nuclear co-evolution drive climate adaptation? This project aims to reveal whether co-evolution between the mitochondrial genome of a wild bird and partner nuclear genes is causing the species to split into two forms, one adapted to inland environments and one to coastal conditions. Mitochondrial-nuclear co-evolution has great potential to illuminate new modes of climate adaptation and lineage divergence. This understanding will provide significant benefits, with implications for conservation management.	$528,847.00	Biological Sciences
DP180102531	Dr Kathryn Hodgins; Professor Roger Cousens; Professor Dr Loren Rieseberg	When is hybridisation helpful or harmful to invaders? This project aims to determine the role of hybridisation during biological invasions. Hybridisation has been thought to aid invasion by introducing genetic novelty, but traditional approaches have been ineffective at evaluating alternatives. The project will capitalise on replicate hybrid zones of the same species, apply new methods on an expansive genomic dataset, and develop novel simulations to resolve how hybridisation and colonisation interact. The methods and knowledge acquired through this research will be valuable for a range of applications, from biosecurity to conservation management.	$308,004.00	Biological Sciences
DP180103725	Associate Professor Carla Sgro	Multiple stressors and vulnerability to global change. This project aims to develop a framework for accurately predicting species responses to environmental change. Future environments will involve shifts in many environmental factors, and species will evolve. Yet we lack understanding of how multiple environmental factors affect the ability of species to evolve and adapt to environmental change. The intended outcome is a tool for predicting the impact of environmental change on the distribution and abundance of organisms. The benefits include improved conservation outcomes and better pest/disease vector control.	$294,720.00	Biological Sciences
DP180101011	Professor Ros Gleadow; Professor Robert Henry; Professor Birger Moeller	Australia's native sorghums. This project aims to investigate the biological mechanisms driving the evolution of toxic cyanogenic glucosides by exploiting the natural diversity of Australian wild relatives of the crop sorghum that are adapted to different environments. Wild crop relatives are an important source of traits for improving their cultivated counterparts. Analysing the diversity and evolution of Australia's 17 native sorghum species will provide new understanding of how plants have adapted to environmental challenges across diverse Australian environments. This should provide significant benefit by providing new resources for plant breeders to produce more climate-resilient crops.	$470,707.00	Biological Sciences
DP180102161	Dr Michael McDonald; Associate Professor Kathryn Holt	Experimental co-evolution of Yeast and E. coli.. This project aims to measure the rates and genetic mechanisms of adaptation for individual species within a microbial community. Expected outcomes of this interdisciplinary project include the first genomic and phenotypic dataset of a model microbial community, and novel tools for the analysis of meta-genomic datasets. This project has the potential to transform understanding of microbial adaptation.	$398,794.00	Biological Sciences

DP180100058	Dr Anne-Marie Peters	Growing up with global change. This project aims to quantify how native bird populations will respond to global warming. The project will investigate how vulnerable nestling birds are to high temperatures, and the impact of early-life heat stress on adult performance and fitness in the wild. Although growing animals are most sensitive to heat, and stress during early-life often has irreversible negative effects, we know very little about long-term consequences of early-life heat stress. The intended outcomes will increase our capacity to predict impacts of climate warming before population declines become evident. Improved predictions are beneficial to identify urgent threats and optimise conservation efforts.	$348,720.00	Biological Sciences
DP180101797	Associate Professor Alistair Evans; Dr Pascal Buenzli; Professor Jukka Jernvall; Professor Peter Dearden	A new universal mechanism controlling body proportions in animals. This project aims to establish that a recently-discovered mechanism, the inhibitory cascade, determines the basic proportions of appendages and body segments in a diverse range of animal groups, particularly vertebrates and arthropods. The goals of the project are to reveal the molecular mechanisms in mice and insects, and build computer simulations to show how to manipulate the control of development by the inhibitory cascade. The project should benefit bioengineering by establishing control mechanisms for the manipulation and regeneration of teeth and limbs.	$422,080.00	Biological Sciences
DP180102193	Professor Dustin Marshall	Dissecting the causes and consequences of non-genetic parental effects. This project aims to determine the consequences of paternal and sperm experience for offspring and the mechanisms by which they occur. This project will make unambiguous tests of paternal effects under field conditions and will unravel the molecular pathways by which they occur. The outcome will be a better understanding of how environmental effects are transmitted through the male line. This will provide significant benefits, such as implications for climate change impacts and reproductive technologies.	$373,164.00	Biological Sciences
DP180104195	Dr Matthew McGee; Professor Dr Ole Seehausen	Uncovering vertebrate lifespan biodiversity with whole genome sequencing. This project aims to integrate existing data on the genetic mechanisms of lifespan evolution in model systems with a novel combination of whole genome sequencing and comparative phylogenomics to reveal the common genomic signatures of lifespan evolution in vertebrates. Expected outcomes include a perspective on the evolution of lifespan, a topic of major health interest for Australia and the rest of the developed world. This will provide significant benefits, such as long-term implications for aging research, with possible business applications. It will also increase Australia's visibility and competitiveness in the developing field of bioinformatics.	$397,872.00	Biological Sciences
DP180101762	Associate Professor Perran Cook; Dr Christopher Greening; Professor Ronnie Glud; Dr Damien Callahan	Hydrogen: an overlooked intermediate during anoxia in permeable sediments. This project aims to quantify the respiratory pathways and the importance of hydrogen as an intermediate during anoxia in permeable (sand) sediments which dominate our coastline. It is anticipated the findings of this project will enable more accurate fundamental understanding of sediment diagenetic processes which control nutrient regeneration and loss pathways in the marine environment. This will enable better management of these environments in the face of increasing coastal population growth.	$411,665.00	Chemistry
DP180103484	Associate Professor Bayden Wood; Dr Philip Heraud; Professor Donald McNaughton; Professor Anton Peleg; Professor Christian Doerig; Professor Royston Goodacre; Dr Darren Creek	Probing antimicrobial drug resistance by multimodal molecular analysis. This project aims to investigate drug resistance in microbial agents. With the emergence of "super bugs" there is a need to understand the biochemistry of antimicrobial resistance. Combining vibrational spectroscopic approaches and metabolomic techniques, the project will investigate cell populations, single cells and subcellular structures in search of biomarkers for drug resistance. The discovery of such biomarkers could lead to improved disease management and eradication programs through identification and treatment of drug resistant pathogens in individuals that have the potential to re-infect the community.	$649,632.00	Chemistry
DP180103444	Dr Ruth Reef; Associate Professor David Kennedy; Dr Vanessa Wong; Professor Tom SPENCER; Dr Susan Brooks; Dr Iris Moeller	The role of vegetated foreshores in stabilising Australia's shorelines. This project aims to improve Australia's capacity to predict shoreline position with sea level rise, identify the role of vegetation in foreshore stabilisation and determine thresholds for shoreline retreat by quantifying the links between biological, geomorphological and sedimentary processes and shoreline position. Sea level rise and potential increases in storminess are predicted to lead to severe impacts and there is an immediate	$323,415.00	Earth Atmosphere & Environment

		and critical need to understand and accurately predict the functioning, dynamics, and distribution of Australia's coastal zones. Expected outcomes of this interdisciplinary project include an integrated modelling framework crucial for planning and management of sea level rise responses in Australia.		
DP180103684	Professor Nicholas Wormald; Dr Anita Liebenau	Enumeration and properties of large discrete structures. This project aims to study a fundamental property of random graphs, by further developing a recently introduced approach to the problem of enumerating graphs with given degrees. Using this new method, the project expects to generate new knowledge on the number of connections that each node has with other nodes in a random graph, and to develop new strategies for counting the graphs or networks with a given property. The project expects to produce new theoretical results as well as enhanced capabilities of mathematical research. Potential benefits arise through the uses of these theoretical combinatorial objects to study naturally occurring networks such as social networks, the network of the world wide web, and chemical compounds.	$388,975.00	Mathematical Sciences
DP180101385	Dr Andrew Hammerlindl; Professor Georg Gottwald; Dr Christian Bonatti; Associate Professor Rafael Potrie	The shape of chaos: geometric advances in partially hyperbolic dynamics. This project aims to use recent advances in geometry and topology to discover new forms of chaotic dynamical systems and further classify the forms of chaos which are possible. Many systems in nature exhibit chaotic dynamics as they change in time. Not all systems are chaotic in the same way, and identifying the form of chaos and its qualitative properties is crucial to truly understanding the system. Chaotic dynamics arise in chemical reactions, celestial mechanics, industrial mixing processes, fusion reactors, and many other processes. This project will aid in predicting the possible long-term behaviours of these systems.	$371,950.00	Mathematical Sciences
DP180100613	Dr Andrea Collevecchio; Associate Professor Timothy Garoni; Associate Professor Kais Hamza; Dr Codina Cotar; Professor Vladas Sidoravicius	Random walks with long memory. This project aims to study novel random walk models with long memory, including systems of multiple random walkers that interact through their environment. This would provide a mathematical understanding of phenomena such as aggregation in colonies of bacteria, and ant colony optimisation algorithms. The project aims to produce highly cited publications, and to train future researchers.	$327,316.00	Mathematical Sciences
DP180104235	Associate Professor Daniel Price; Dr Christophe Pinte; Professor Giuseppe Lodato	Gaps, rings and holes in protoplanetary discs. This project aims to provide a theoretical interpretation for recent observations of protoplanetary discs. Recent first images from the Atacama Large Millimetre Array (ALMA) telescope in Chile and the Very Large Telescope (VLT) have provided a snapshot of planets forming around young stars. This project will use three-dimensional simulations to understand how newborn planets can carve structures such as 'gaps' and 'holes' seen by telescopes. The project aims to develop an algorithm, capable of simulating a mixture of gas and multiple types of solid particles, which is applicable in astronomy and engineering.	$369,365.00	Physics and Astronomy
DP180103155	Dr Paul Lasky	Putting Einstein to the test: Probing gravity with gravitational waves. This project aims to capitalise on the momentous discovery of gravitational waves by the Laser Interferometer Gravitational-wave Observatory (LIGO). In 2016, the LIGO Scientific Collaboration announced the first detection of gravitational waves coming from the collision of two massive black holes approximately one billion light years from Earth. The project aims to use proprietary LIGO data, of multiple gravitational-wave observations, to perform unprecedented tests of Einstein's theory of gravity in regions of the Universe where new physics is most likely to occur - at the surfaces of black holes. The project is designed to develop the foundation of gravitational-wave astronomy for the next three-to-five years.	$238,048.00	Physics and Astronomy
DP180100533	Professor Moira O'Bryan	Mechanisms of manchette function. This project aims to define the function of the manchette, a poorly understood microtubule-based structure present in haploid male germ cells. This project aims to define key mechanisms underpinning manchette development and movement, and to generate a detailed picture of the dynamics of germ cell development using imaging technologies and unique animal models. Such knowledge should improve the understanding of how male fertility is achieved, the origin of infertility and how species-specific differences in sperm form are achieved. Such insights may ultimately lead to improved agricultural efficiencies and job creation.	$375,006.00	Biological Sciences

B. Awarded grants - administered through another faculty of Monash University or an external institution

As of 10/11/2017 the below are the only known successful proposals with involvement of researchers from the Faculty of Science.

Project ID	Investigator(s)	Summary	Administrating Organisation	Funding Awarded	School
DP180103769	Professor Rob Atkin; Professor Gregory Warr; **Dr Rico Tabor;** Professor Agilio Padua	Ionic lquids for scalable production of monolayer two-dimensional materials. This project aims to produce stable solutions of high quality, two-dimensional materials (2DMs, exemplified by graphene) in ionic liquids by spontaneous exfoliation. The project will develop processes for producing significant quantities of high quality 2DMs for use in a diverse range of technologies, and train graduate students in experimental and computational chemistry techniques.	The University of Western Australia	$238,048.00	Chemistry
DP180103891	Professor Paul Norbury; Dr Daniel Murfet; **Dr Norman Do**	Frobenius manifolds from a geometrical and categorical viewpoint. This project aims to provide connections between Frobenius manifolds obtained from algebraic curves in diverse ways. The different constructions, using complex geometry on the one hand and category theory on the other, provide, respectively, a quantitative and qualitative view on the same Frobenius manifold. Together, these distinct points of view allow for the calculation of previously inaccessible physical quantities, and point to deep new relations between algebraic, complex and differential geometry. These relations are expected to guide new fundamental research on the border of mathematics and physics.	The University of Melbourne	$371,950.00	Mathematical Sciences
DP180101170	Professor Xiaodong Li; **Professor Andreas Ernst;** Professor Kalyanmoy Deb	Hybrid methods with decomposition for large scale optimization. This project aims to develop advanced approaches for solving large scale real-world optimisation problems that are expensive to evaluate, and difficult to formulate, involving thousands of variables and constraints. The project will make novel contributions to improving state-of-the-art large scale optimisation algorithms in terms of scalability, effectiveness, and efficiency for real-world problem solving. The outcomes of this project will bring about greater understanding of real-world large scale optimisation, and deliver practical solutions to these problems.	RMIT University	$352,616.00	Mathematical Sciences

ARC LIEF for funding commencing in 2018 (LE18)

Awarded Grants – Science led

The Faculty of Science at Monash University has CI involvement on 2 successful proposals submitted through external institutions.

Project ID	Investigator(s)	Summary	School	Funding Awarded
LE180100054	Professor Michael Fuhrer; Dr Mark Edmonds; Professor Udo Bach; Professor Kiyonori Suzuki; Dr Julie Karel ; Professor Kourosh Kalantar-zadeh; Associate Professor Lan Wang; Professor Vipul Bansal; Dr Jianzhen Ou; Associate Professor Jan Seidel; Dr Jiabao Yi; Associate Professor Yuerui Lu	Facility for electric and magnetic probes of materials at extreme conditions. This project aims to establish a readily accessible facility for measurement of electric and magnetic properties of materials under extreme temperature, magnetic field, and sensitivity conditions. The expected outcome is to build capacity for and support world-leading research into novel topological materials, atomically thin materials, materials with strong light-matter interactions and magnetic materials. The benefits to society are new devices for efficient generation, storage, transmission and switching of energy.	Sch of Physics & Astronomy	$824,080.00
LE180100180	Professor Philip Marriott; Professor Craig Williams; Professor Jamie Rossjohn; Professor Alan Chaffee; Professor James De Voss; Associate Professor Russell Barrow	Gas chromatography: separating inseparables, identifiying unidentifiables. This project aims to provide researchers with an integrated capability for separation, isolation, and precise structural identification of volatile compounds. It expects to deliver a systematic solution using unprecedented, automated multidimensional gas chromatographic separation, isolating pure compounds for off-line characterisation using appropriate spectroscopic tools, for example nuclear magnetic resonance. This will provide significant benefits, such as permitting traceability of (bio)-synthetic pathways, better characterise chemical signalling in plants, accelerate identification of advanced intermediates required for total synthesis of alkaloids, improve detection of metabolites, and determine interactions between small allergens and proteins.	Sch of Chemistry	$299,105.00
LE180100058	Associate Professor Steven Micklethwaite; Professor Jeffrey Walker; Dr Rohan Clarke; Professor Nigel Tapper; Professor Leigh Sullivan; Professor Tom Drummond; Dr Simon McClusky; Professor Mohammad Murshed; Professor Guojun Lu; Associate Professor Peter Dahlhaus; Associate Professor Singarayer Florentine; Dr Ivan PopStefanija; Associate Professor Timothy Rawling	Unmanned aerial vehicle sensing and data discovery for a changing planet. This project aims to establish an earth systems monitoring facility, using unmanned aerial vehicles and world-leading sensor technology. It will have the capability to measure the natural and built environment at millimetre to centimetre scales and to monitor rapid changes. The ensuing data and interpretations will be useful for decision-making and policy development amongst government agencies and the agricultural, environmental, civil infrastructure and mining industries.	Sch of Earth Atmosphere & Environment	$659,060.00

Awarded Grants – Non-Science led

Project ID	Investigator(s)	Summary	Administering Organisation	Funding Awarded	Faculty of Sci School
LE180100009	Professor Matthew Colless; Dr Elisabete da Cunha; Dr Dougal Mackey; Professor Scott Croom; Professor Christopher Blake; Dr Edward Taylor; Professor Michael	Doubling the power of a unique astronomical survey facility. This project aims to double the number of fibres in the spectrograph on the UK Schmidt Telescope and so double the number of stars and galaxies that it can observe simultaneously. This would allow rapid	The Australian National University	$340,160.00	Sch of Physics & Astronomy

	Drinkwater; Professor Tamara Davis; Associate Professor Sarah Brough; Dr Duncan Wright; Professor Simon Driver; **Associate Professor Michael Brown;** Professor Raymond Norris; Adjunct Professor Andrew Hopkins	and timely completion of two major projects: the Taipan galaxy survey would be first to test a potential discrepancy in the expansion rate of the universe that may signal new physics, while the FunnelWeb stellar survey would (in tandem with two space missions) identify potential nearby exoplanets and trace the history of the Milky Way. The benefits include high scientific impact for the two surveys, international showcasing of the Australian Starbug technology, and a national astronomical survey facility for the next decade.			
LE180100142	Professor Christopher Vale; Professor Andrei Sidorov; Professor Peter Hannaford; Professor Peter Drummond; Professor John Close; Associate Professor Andrew Truscott; Associate Professor Nicholas Robins; Professor Robert Scholten; Associate Professor Andrew Martin; Professor Halina Rubinsztein-Dunlop; Professor Matthew Davis; **Professor Kristian Helmerson; Dr Lincoln Turner; Associate Professor Meera Parish;** Professor Dr Tilman Pfau	Australian quantum gas microscope. This project aims to create a quantum gas microscope for ultra-cold dysprosium atoms, realising a versatile system for quantum emulation, tests of fundamental, atom interferometry, and precision measurement. Quantum gas microscopy is a frontier area allowing atom-by-atom synthesis and probing of tailored quantum materials such as topological insulators. Using the lanthanide element dysprosium, which is highly magnetic and possesses both bosonic and fermionic isotopes, this facility will serve the needs of multiple research groups with diverse scientific interests.	Swinburne University of Technology	$727,900.00	Sch of Physics & Astronomy