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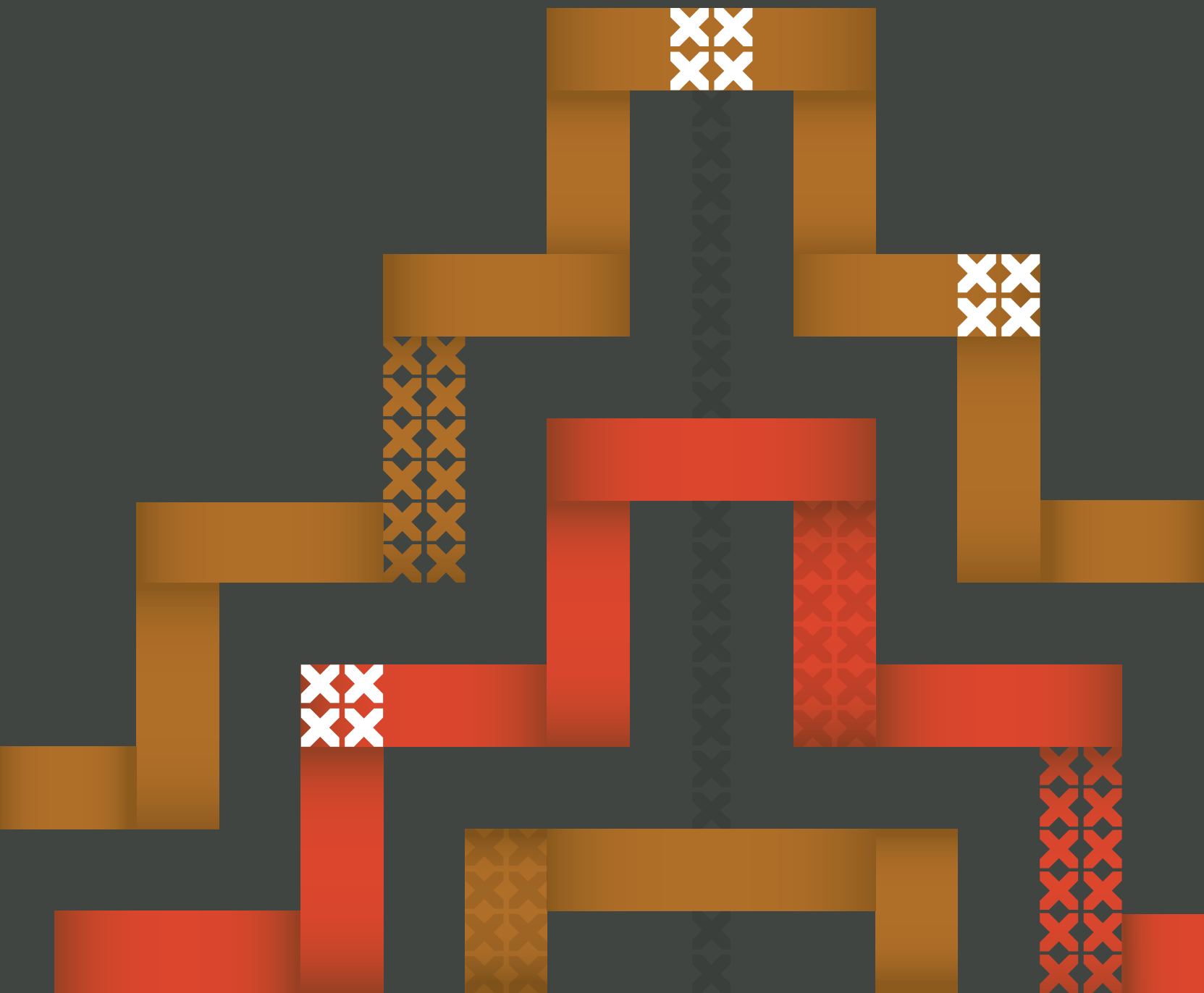
TE PŪTEA RANGAHAU A MARSDEN

MARSDEN FUND UPDATE

MARSDEN FUND
TE PŪTEA RANGAHAU A MARSDEN

ROYAL SOCIETY TE APĀRANGI



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Te Kāwanatanga o Aotearoa
New Zealand Government

**Ministry of Business,
Innovation & Employment**

The cover is a contemporary design of two tukutuku patterns. The first poutama symbolises levels of attainment, advancement and growth – striving ever upwards for the betterment of all hapori communities. The second element is purapura whetū, a pattern that represents stars and the great number of people of our nation.

RĀRANGĪ ŪPOKO CONTENTS

SECTION

Sir Ernest Marsden

MŌ TE PŪTEA RANGAHAU A MARSDEN

E tautoko ana te Pūtea Rangahau a Marsden i te hiranga i roto i ngā rangahau tino mātāmua rawa i Aotearoa. Ka tīpakohia ngā kaupapa i ia tau mā tētahi tukanga pakari e ngā rōpū whiriwhiri tekau e ārahina ana e ngā whakaaro o ngā kairangahau ā-ao, whakaihuwaka ā-ao hoki. Ko te tikanga ka rato ngā pūtea ki te toru tau mō ia takuhe.

E toru ngā momo takuhe: Atu ki te $3 miriona (kore GST) te wāriu o ngā takuhe a Te Tohu Kaunihera Pūtea Rangahau a Marsden i roto i te toru tau; Atu ki te $960K (kore GST) te wāriu o ngā takuhe Arowhānui mō te toru tau; ā, atu ki te $360K (kore GST) te wāriu o ngā takuhe Arowhānui mō te toru tau mā ngā kairangahau pūhou. Ka utua e ngā takuhe ngā utu ā-tau, ngā tūranga ākonga me te kairangi, me ngā taonga hoki.

He kairapu te Pūtea Rangahau a Marsden, ā, mō ngā kaupapa ā-kaitūhura, ka mutu kāore e herea ana ki ngā kaupapa matua a te kāwanatanga. E whakahaerehia ana e Te Apārangi, ā, nā te Kāwanatanga o Aotearoa te pūtea.

He mea whakaingoa te Pūtea Rangahau a Marsden ki te kaiahupūngao a **Tā Ernest Marsden**. He mea whakatū e te kāwanatanga i te tau 1994. E kīia ana ko te Pūtea Rangahau a Marsden te taumata o te hiranga, e taea ai e ngā kairangahau toa rawa o Aotearoa te hōpara i ō rātau huatau.

MŌ TE APĀRANGI

He whakahaere huamoni-kore motuhake a Te Apārangi e tautoko ana i ngā tāngata o Aotearoa ki te hōpara, tūhura me te tuari mōhiotanga. Ka tuku pūtea mā ana kaupapa me te tuku whai wāhitanga akoranga ki ngā kairangahau, kaiako, ākonga kura, me rātau e pakiki ana ki te ao.

Hei whakanui i ngā tūhuratanga o ngā kairangahau o Aotearoa, ka whakawhiwhia e Te Apārangi ngā mētara me te tohu Pūkenga, he manukura nō ō rātau wāhanga. Ka āwhina ēnei tohunga i te Apārangi ki te tuku tohutohu motuhake ki ngā tāngata o Aotearoa me te kāwanatanga mō ngā take e arohia ana e te iwi whānui.

He whānui te kōtuinga mema me ngā hoa o Te Apārangi puta noa i Aotearoa me te pōhiri i te hunga e kaingākau ana ki ngā mahi a ngā tāngata o Aotearoa ki te hōpara, tūhura me te tuari mōhiohio kia whakauru mai.

Mō ētahi atu kōrero anō haere ki
royalsociety.org.nz

ABOUT THE MARSDEN FUND

The Marsden Fund supports excellence in leading-edge research in New Zealand. Projects are selected annually in a rigorous process by ten panels which are guided by the opinions of world-leading, international researchers. Funding is usually spread over three years for each grant.

There are three types of grants: Marsden Fund Council Award grants worth up to $3 million (excl. GST) over three years; Standard grants that can be worth up to $960K (excl. GST) for three years; and Fast-Start grants worth $360K (excl. GST) over three years for early career researchers. Grants pay for salaries, students and postdoctoral positions, and consumables.

The Marsden Fund is contestable, is for investigator-driven research projects, and is not subject to government priorities. It is administered by Royal Society Te Apārangi and funded by the New Zealand Government.

The Marsden Fund is named after physicist **Sir Ernest Marsden**. It was established by the government in 1994. The Marsden Fund is regarded as a hallmark of excellence, allowing New Zealand's best researchers to explore their ideas.

ABOUT ROYAL SOCIETY TE APĀRANGI

Royal Society Te Apārangi is an independent, not-for-profit organisation that supports all New Zealanders to explore, discover and share knowledge. Its varied programmes provide funding and learning opportunities for researchers, teachers and school students, together with those who are simply curious about the world.

To celebrate the discoveries of New Zealand researchers, the Society awards medals and elects Fellows, who are leaders in their fields. These experts help the Society to provide independent advice to New Zealanders and the government on issues of public concern.

The Society has a broad network of members and friends around New Zealand and invites all those who value the work New Zealanders do in exploring, discovering and sharing knowledge to join with them.

Te Pūtea Rangahau a Marsden is managed by Royal Society Te Apārangi on behalf of the New Zealand Government with funding from the Ministry of Business, Innovation and Employment. Nā te Hīkina Whakatutuki te mana hāpai.

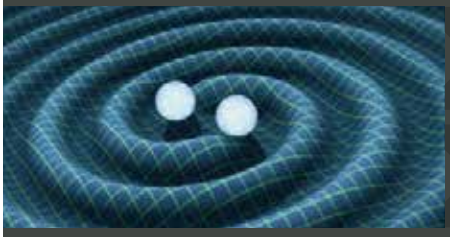
To discover more visit royalsociety.org.nz

01 /

PROJECT HIGHLIGHTS FROM NEW MARSDEN FUND AWARDS

SUPPORTING WORLD-LEADING RESEARCH

In 2021, the Marsden Fund Te Pūtea Rangahau a Marsden allocated $82.345 million (excluding GST) to 120 research projects led by researchers in Aotearoa. These grants support excellent research in the humanities, science, social sciences, mātauranga, mathematics, and engineering.



This year, one large interdisciplinary project received the prestigious Marsden Fund Council Award worth $3 million (excluding GST).

The project will investigate ways to decipher gravitational waves – ripples in space-time caused by accelerating massive objects. An extensive collaborative team will link expertise in mathematics, computational science, fundamental physics, and novel statistical methodologies from across Aotearoa to facilitate gravitational wave science and participation in the international Laser Interferometer Space Antenna (LISA) mission.

Established researchers and their teams were awarded 75 Marsden Fund Standard grants with a success rate of 10.2%.

The research projects address a wide range of issues of both local and international importance: from how we age; understanding the mechanism of an artificial nose; how body temperature is regulated during pregnancy; through to investigating whether the building blocks of life can form in the atmosphere of Titan, Saturn's largest moon.

Marsden Fund Fast-Start grants support early career researchers to develop independent research and build exceptional careers in Aotearoa. In 2021, there were 44 recipients for a total of $15,840,000 (excluding GST), with a success rate of 10.8%.

Projects cover a broad range of topics, such as: Cook Islands Māori language; young onset Parkinson's disease; the effects of climate change on the kuku green lipped mussel; more sustainable South Pacific tourism in a Covid-19 world; and how girls deal with the potential dangers of online media.

The research projects are of world-class standard and have undergone a highly rigorous selection process, including substantial international peer review. Marsden Fund Council Chair **Professor David Bilkey** says, "Te Pūtea Rangahau a Marsden is a fund designed to enable and create momentum for our leading and up-and-coming researchers to develop their most innovative and ambitious ideas. This support of fundamental 'blue-sky' research is crucial to ensuring a healthy, vibrant and resilient research culture in Aotearoa, capable of addressing major societal challenges, as we have seen recently with the response to the Covid-19 pandemic.

"The range of knowledge represented in this year's funded research is something to be proud of, with research excellence and scholarly impact in areas such as hauora health, climate, and languages. The outcomes of this research will benefit Aotearoa in many ways, for example, by helping us to better understand who we are and by discovering novel solutions for some of our most pressing problems.

"It's great to see the increasing engagement with mātauranga Māori, which has been recognised across a range of disciplines", notes Professor Bilkey. "Some examples include studies investigating the cultural importance, sustainability and affordability of urupā tautaiao (natural burials); exploring the potential for green innovation – including by Māori – in the environmental impact of body disposal; the genetic variations associated with gout; and using cutting edge tools to better align archaeological findings with Māori history. Some of the funded projects have also committed to supporting early career Māori researchers through endeavouring to recruit Māori students – an effort we commend for its potential positive impact on the under-representation of Māori in academia.

The projects funded in this round will help fulfil one of the Marsden Fund Council's goals for the fund:

Ka pūmau tonu te hapori mātanga i te katoa me te whānuitanga o ngā kaupeka rangahau.

Maintain a New Zealand community of experts in the full, and expanding, range of research fields.

"Many of this year's awarded Marsden grants include opportunities for the training of postgraduate students. As the Marsden Fund Council is particularly keen to support the development of the next generation of emerging researchers, we have been working diligently on the initiative to raise the value of Marsden scholarships for several months. After careful consideration, we have increased the value of PhD scholarships from $27,500 per year to $35,000 per year and Masters scholarships from $17,000 to $22,000. These increases will benefit any postgraduate students recruited on these new grants," Professor Bilkey said.

The overall success rate for applicants is down slightly from last year (11.5.%) to 10.4% this year. The main reason for this is that the budget cap for Fast-Start awards increased this year (from $300,000 to $360,000 over the project life), decreasing the number of Fast-Start projects that could be funded.

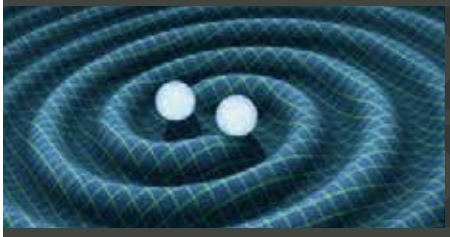
The grants are distributed over three years and are fully costed; paying for salaries, students and postdoctoral positions, institutional overheads, and research consumables.

01 /

KA TAUTOKO TE PŪTEA MARSDEN I NGĀ RANGAHAU AUAHA I AOTEAROA

I NGĀ RANGAHAU MĀTĀMUA O TE AO

He $82.345 miriona (kore GST) kua tohaina e Te Pūtea Rangahau a Marsden ki ngā kaupapa rangahau 120 e ārahina ana e kairangahau i Aotearoa. E tautoko ana ēnei takuhe i ngā rangahau hiranga i roto i ngā mātauranga toi tangata, pūtaiao, te mātauranga pāpori, mātauranga, pāngarau, me te pūkaha mō te toru tau.



I tēnei tau kotahi te kaupapa pūkenga whitiwhiti nui i whiwhi i te Tohu Kaunihera Pūtea a Marsden whai mana mō te $3 miriona (kore GST).

Ka tūhura te kaupapa i ngā āhuatanga hei wetewete i ngā ngaru tō ā-papa – ngā riporipo i te mokowā-wā ka pā mai i te whakahohorotanga o ngā ahanoa nunui. Ka whakahiato mai te rōpū mahi tahi whānui e arahina ana e ahorangi Renate Meyer o Waipapa Taumata Rau i ngā pūkenga o te pāngarau, pūtaiao rorohiko, te ahupūngao taketake me ngā tikanga mahi tatauranga rerekē puta noa i Aotearoa hei tuku whai wāhitanga matua ki te pūtaiao ngaru tō ā-papa me te takawaenga i te whai wāhitanga ki te whakatakanga LISA (Laser Interferometer Space Antenna) o te ao.

I whakawhiwhia ngā kaiārahi tautōhito me ō rātau rōpū ki ngā takuhe Pūtea Marsden Arowhānui 75 me te auau angitu o te 10.2%.

Ka whakarite ngā kaupapa rangahau i ngā tūmomo raru whānui e hira ana ki te motu me te ao; he pēhea tō pakeketanga, te mārama ki te āhuatanga ihu horihori; he pēhea te whakahaere i te pāmahana i te wā e hapū ana; tae atu ki te tūhura mēnā ka taea ngā mea taketake o te ora te waihanga i te kōhauhau o Titan, te marama nui rawa o Saturn.

E tautoko ana ngā takuhe Tīmata Wawe a te Pūtea Marsden i ngā kairangahau pūhou ki te whakawhanake i ngā rangahau motuhake me te waihanga i ngā ara mahi tino rawe i Aotearoa.

I te 2021, 44 te hunga i whakawhiwhia ki ngā takuhe Tīmata Wawe, he $15,840,000 (kore GST) te rahinga. He 10.8% te auau angitu mō ēnei tohu.

Kei roto i ngā kaupapa i whiwhi pūtea i tēnei ko ngā tūmomo mea pērā i te tūhura i ngā te reo Kuki Airani Māori; te pānga tōmua mai o te mate Parkinson; te pānga o te huringa āhuarangi ki ngā kuku; kia nui ake ngā mahi tāpoi toitū i Te Moana Nui-a-Kiwa i te ao KOWHEORI-19; ā, he pēhea te whakarite a ngā kōtiro i ngā mōrearea me ngā painga pāpori ka taea mai i te ao pāpāho.

He taumata tiketike rawa ngā kaupapa rangahau, ā, i puta i tētahi tukanga whiriwhiringa tino pakari, tae atu ki te aropā ā-ao nui. I kī te Heamana o te Kaunihera Pūtea a Marsden a **Ahorangi David Bilkey**, "ko Te Pūtea Rangahau a Marsden he pūtea i hangaia hei whakamana kia anga whakamua ai mō ā mātau kairangahau mātāmua, pūhou hoki hei whakawhanake ai ō rātau whakaaro auaha, hao nui hoki. He mea hira te tautoko i ngā rangahau 'rangi kikorangi' mō te whakarite i tētahi ahurea hauora, toritori, pakari hoki i Aotearoa, e taea ai te whakarite ngā whakapātaritari ā-iwi matua, pērā i tērā i kite tātau mō te urupare ki te urutā KOWHEORI-19.

"Ko ngā tūmomo mōhiotanga kei roto i ngā rangahau whai pūtea i tēnei tau he mea whakahī i te ngākau, me te hiranga o te rangahau me te pānga o te mātauranga i ngā wāhi pērā i te hauora, te āhuarangi me ngā reo. Ko Aotearoa ka whiwhi i ngā painga o tēnei rangahau i roto ngā āhuatanga maha, hei tauira, mā te āwhina i a tātau kia mārama ake ko wai tātau me te tūhura i ngā rongoā rerekē mō ētahi o ā tātau raruraru kōhukihuki.

"He rawe kē te kite i te nui haere o te whai i te mātauranga Māori, ā, e āhukahukatia ana i roto i ngā tūmomo pekanga mātauranga", te kī a Ahorangi Bilkey. "Kei roto i ētahi tauira ko ngā rangahau e tūhura ana i te hiranga ahurea, te toitūtanga me te whai utu o ngā nehunga māori; te hōpara i te auahatanga tiaki taiao ka taea – tae atu ki ērā a te Māori – mō te pānga ki te taiao mō te whakawātea tūpāpaku; ngā rerekētanga ā-ira e pā ana ki te porohau; me te whakamahi i ngā utauta tino hou rawa kia pai ake ai te whakahāngai i ngā kitenga whaipara ki te hītori Māori. Ko ētahi o ngā kaupapa i whiwhi pūtea e pūmau ana ki te tautoko i ngā kairangahau pūhou Māori mā te tiki i ngā ākonga Māori – e mihi ana mātau mō ngā pānga pai puta mō te iti rawa o te Māori i roto i te mātauranga.

Ko ngā kaupapa i whai pūtea i tēnei rauna ka āwhina ki te whakatutuki i tētahi o ngā whāinga a te Kaunihera Pūtea a Marsden mō te pūtea:

Ka pūmau tonu te hapori mātanga i te katoa me te whānuitanga o ngā kaupeka rangahau.

"Kei roto i te maha o ngā takuhe Marsden i whakawhiwhia i tēnei tau ko ngā whai wāhitanga mō te whakangungu i ngā ākonga paetahi. I te mea e hiahia ana te Kaunihera Pūtea Marsden ki te tautoko i te whanaketanga o te reanga whai ake o ngā kairangahau pūhou, e pukumahi ana mātau me tēnei kaupapa ki te hiki i te wāriu o ngā karahipi Marsden mō ngā tau maha. I muri i te āta whiriwhiritanga, kua whakapikihia e mātau te wāriu o ngā karahipi Tohu Kairangi mai i te $27,500 i te tau ki te $35,000 i te tau, ā, mō ngā karahipi Tohu Paerua mai i te $17,000 ki te $22,000. Ko ngā ākonga paetahi ka whiwhi i ngā painga o ēnei takuhe hou," te kī a Ahorangi Bilkey.

Kua āhua heke te rahinga o ngā kaitono i waimarie mai i tērā tau (11.5%) he 10.4% i tēnei tau. Ko te take matua mō tēnei ko te pōtae tahua mō ngā tohu Tīmata-Wawe kua whakapikihia i tēnei tau (mai i te $300,000 ki te $360,000 i roto i te roanga o te kaupapa), ka whakaiti i te maha o ngā kaupapa Tīmata-Wawe ka taea te tuku pūtea.

Ka tohaina ngā takuhe i roto i te toru tau ka mutu e whānui ana te whai pūtea, e utu ana i ngā utu ā-tau, ngā tūranga ākonga me te kairangi, ngā whakapaunga ā-whare wānanga me ngā taonga rangahau.

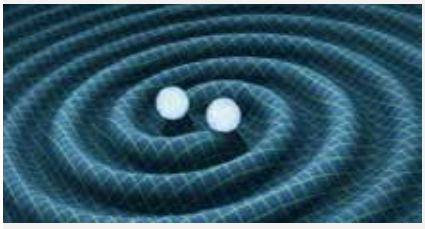
LISA Pathfinder lifting off on VV06.
Image: ESA–Stephane Corvaja, 2015

02 /
MARSDEN FUND COUNCIL AWARDS

DECIPHERING GRAVITATIONAL WAVES

AND DECODING SIGNALS FROM THE UNIVERSE

In this Marsden Fund Council Award project, Professor Renate Meyer from the University of Auckland will lead a multi-institutional team that will make core contributions to gravitational wave science and facilitate participation of Aotearoa New Zealand scientists in the international 'Laser Interferometer Space Antenna' (LISA) mission.



Schematic illustrations of gravitational wave production immediately prior to a black hole merger.
Images: Caltech

Gravitational waves – ripples in space-time caused by accelerating massive objects – were predicted by Einstein's theory of general relativity in 1916, but they weren't directly measured until 2015. Whereas light waves have provided a picture of the Universe back to 400,000 years after the Big Bang, gravitational waves can give us information all the way back to a fraction of a second after the Big Bang. This ground-breaking discovery has marked the beginning of a revolution in astronomy. To clearly decipher these weak gravitational wave signals from instrumental noise, it is essential to carefully characterise the noise using statistical methods.

A new LISA mission is being developed by the European Space Agency with the goal of launching in 2034. LISA will measure low frequency gravitational waves, offering ringside seats to mergers of black holes and neutron stars, which are among the most enigmatic objects in the Universe. Professor Meyer will lead a large interdisciplinary team bringing together expertise in mathematics, computational science, fundamental physics and novel statistical methodologies to make core contributions to gravitational wave science and facilitate participation in the LISA mission. The team will look at both the statistical challenges faced when attempting to extract the gravitational wave signals from the raw data, and the properties of key sources of gravitational waves.

The team's goal is to build momentum for a decades-long collaboration with international teams in one of the world's most exciting scientific endeavours. By doing so they will help realise the potential of gravitational wave observatories to advance stellar astronomy, galactic astrophysics, and fundamental particle physics.

Read more about gravitational waves in Research Updates
Bit.ly/MF57-52

TE WHAKAMATARA I NGĀ NGARU

TŌ Ā-PAPA ME TE WETEWETE I NGĀ TOHU MAI I TE AO TUKUPŪ

I tēnei kaupapa o te Tohu Kaunihera Pūtea a Marsden, ka arahina e Ahorangi Renate Meyer o Waipapa Taumata Rau tētahi rōpū nō ngā whare wānanga maha ka tuku i ngā takoha nui ki te pūtaiao ngaru tō ā-papa me te takawaenga i te whai wāhitanga o ngā tohunga pūtaiao o Aotearoa i roto i te whakatakanga 'Laser Interferometer Space Antenna' (LISA) o tāwāhi.

I matapaetia ngā ngaru tō ā-papa – ko ngā riporipo i te wā-ātea nā te whakahohoro i ngā ahanoa nunui – e te ariā a whaiahu arowhānui a Einstein i te tau 1916, engari nō te tau 2015 i inea tōtikatia. Nā ngā ngaru tūrama kua whānui te kite i te Ao Tukupū tae noa ki te 400,000 tau ki mua i muri i te Pahū Nui, ka tuku mōhiohio ngā ngaru tō ā-papa ki a tātau tae noa ki tētahi hautanga hēkona i muri i te Pahū Nui. Nā tēnei kitenga tuatahitanga whakaharahara kua tīmata i tētahi hurihanga hou o te tātai arorangi. Kia āta wetewete ai i ēnei tohu ngaru tō ā-papa ngoikore mai i te tangi o ngā taputapu, he mea nui kia āta mōhio ki te tangi mā te whakamahi i ngā tikanga tatauranga.

Kei te hangaia he whakatakanga LISA hou e te European Space Agency, ā, ko te whāinga kia whakarewa hei te tau 2034. Ka inea e LISA ngā ngaru tō ā-papa auau pāpaku, e whakarato ana i ngā tūru paemua ki ngā hanumitanga o ngā rua pango me ngā whetū iramoe, i roto i ngā ahanoa aupiki i te Ao Tukupū. Ka arahina e Ahorangi Meyer tētahi rōpū pūkenga-maha nui e whakatōpū ana i ngā pūkenga o te pāngarau, pūtaiao rorohiko, te ahupūngao taketake me ngā tikanga mahi tatauranga rerekē hei takoha matua ki te pūtaiao ngaru tō ā-papa me te takawaenga i te whai wāhitanga atu ki te whakatakanga LISA. Ka tirotiro te rōpū ki ngā whakapātari tatauranga ka pā mai ina whakamātau ana ki te tango i ngā tohu ngaru tō ā-papa mai i ngā raraunga taketake me ngā āhuatanga o ngā puna hira o ngā ngaru tō ā-papa.

Ko te whāinga a te rōpū he whakaemi kaha mō te mahi tahi i roto i te tekau tau me ngā rōpū o tāwāhi i tētahi o ngā umanga pūtaiao whakaongaonga rawa atu o te ao. Mā te whai i tēnei ka āwhina i a rātau ki te whakatutuki i te pūmanawa nohopuku o ngā whare kōkōrangi hei kōkiri whakamua i te mātauranga tātari arorangi, ahupūngao kōkōrangi whetū, me te ahupūngao korakora taketake.

Read more about gravitational waves in Research Updates
Bit.ly/MF57-52

(From top, L-R) R Meyer, PA Maturana-Russel, NL Christensen, YC Perrott, EA Lim, RJM Easther, JC Niemeyer, MF Parry, JJ Eldridge, MC Edwards, K Lee, WHB van Straten, J Frauendiener, C Gordon.

Above: Illustration of LISA circling the Sun in an Earth-trailing orbit. LISA is an European Space Agency mission, in cooperation with NASA, slated for launch in the mid-2030s. Image: ESA

03 /

MARSDEN FUND STANDARD AWARDS

THE CULTURAL AND LITERARY HISTORY OF TABOO

Dr Alex Calder, University of Auckland, will be tracing the history of the concept of taboo. The term entered the English language in the wake of Cook's voyages and comes from a word found across the Pacific: tapu in Māori, tabu in Tahitian, kapu in Hawaiian.

Early pākehā who first encountered tapu were puzzled by the range of its meanings. They knew to expect different customs, but what they came to call 'taboo' pointed to something more: a mentality, or as we now say, a culture. Almost everyone who wrote about the Pacific in the first half of the 19th century had something to say about taboo. They expressed what was, at best, an incomplete knowledge of the Indigenous cultures they wrote about, but the information they gathered would go on to generate new forms of knowledge about social behaviour and beliefs.

Taboo was a puzzle because it seemed to mean sacred, yet it also applied to things and situations that, to a Western mind, were far from sacred—that involved aspects of dangerous contagion or uncleanness.

Scholars soon identified similar patterns in the world from which the Hebrew Bible emerged. Speculations about taboo by scientists and philosophers encouraged people in the West to know themselves and their own cultures more deeply by showing how taboo was part of their own lives. Taboo prompted major work in anthropology, religion, and psychology – and would eventually help dismantle notions of 'primitive thinking'. It inspired literature too, including Coleridge's Ancient Mariner, Melville's Moby-Dick, and even vampire folklore.

This Marsden Fund Standard project will be the first to interweave the history of taboo with its wider cultural, scholarly and literary contexts. It will also fund doctoral research into the history of tapu from a Māori perspective. For centuries we have traced the impact of Europe on Polynesia. This project looks more closely at currents running the other way.

Dr Alex Calder

DO SPIDERS COUNT?

Dr Fiona Cross, University of Canterbury, will investigate what numbers mean to jumping spiders, to see if they can be counted on to help researchers better understand numerical cognition in animals.

Can animals sense numbers? Biologists have investigated this question by studying vertebrates like apes, birds, and fish, and invertebrates like bees. We know that animals do sense the number of things when they are differentiating individual objects, and this ability to quantify is independent from mathematical notation and verbal language. Do these discoveries hold true for spiders?

With this Marsden Fund Standard grant, arachnologist Dr Fiona Cross and her team will examine this question in jumping spiders, which have a unique set of eyes they use to target other spiders as preferred prey. This makes them an exceptional case to study numerical cognition in animals. The proposed research brings together a custom virtual reality setup and eye-tracking equipment to visualise in real time how jumping spiders can differentiate visual objects or cues. Visual data will be combined with theories in psychology to build a complete picture of how the spiders interpret mathematic-like relations without a formalised mathematical system.

This research will provide a deeper understanding of animal cognition, as well as the origin of mathematics. It may even bring us closer to being able to answer philosophical questions like: is mathematics only a human descriptor of the physical world, or is it innate to all life? The custom-made virtual reality setup also pushes the boundaries of what is experimentally possible in the virtual space, highlighting the gains that can be made when completely different disciplines collide.

Portia Africana spider, and Dr Cross with Professor Robert Jackson in the field

A NEW WAY TO STUDY GOUT

IN MĀORI AND PACIFIC POPULATIONS

Associate Professor Alex Gavryushkin, University of Canterbury, and Professor Michael Witbrock, University of Auckland, will develop a novel computational tool for learning the genetic variations associated with the cause of gout.

Associate Professor Gavryushkin and colleagues from the Biological Data Science Lab, 2019

Gout is a painful form of inflammatory arthritis that disproportionately affects Māori and Pacific populations. It arises when urate crystals form in the joints, which happens when there are high levels of urate in the bloodstream. Genetic differences between people lead to variations in urate levels, influencing each person's risk of developing gout. Being able to predict high urate levels from a person's genetic makeup could lead to better health outcomes for gout sufferers. Previous researchers working on this problem used a powerful statistical technique called a genome-wide association study. However, this commonly used technique has limitations in predictability.

Attention-based deep neural network models are a recent innovation that have been successfully applied to some of the most challenging problems in computational biology (for example, image recognition and prediction of protein structure). In this Marsden Fund Standard grant, Associate Professor Gavryushkin and Professor Witbrock will coordinate a team including **Dr Megan Leask** (Kāi Tahu, Kāti Mamoe), **Dr Karaitiana Taiuru** (Ngāti Tahu, Ngāti Kahungunu, Ngāti Toa), and **Professor Tony Merriman** to develop an attention-based approach to genome-wide association studies. This project will be the first of its kind to explore the contribution of genetic interactions to disease. They will train the new tool with a large gout dataset from the UK, supplemented with data from a smaller cohort of Māori and Pasifika individuals. Techniques will be developed to eliminate biases in the data, and, since the genetic data represents whakapapa, tikanga will be at the forefront of the team's approach. Whānau, hapū and iwi will be actively involved in interpretation of the data.

The project will contribute to the team's long-term aim of developing a widely applicable tool that can be used for many different diseases. By informing improved treatment and diagnostics for Māori and Pasifika with regards to gout, the team's research will also contribute to more equitable access to genetic services.

HE TIKANGA HOU MŌ TE RANGAHAU I TE POROHAU

I NGĀ TAUPORI MĀORI ME TE MOANANUI-A-KIWA

Ka hangaia e Ahorangi Tuarua Alex Gavryushkin mai i Te Whare Wānanga o Waitaha, me Ahorangi Michael Witbrock mai i Waipapa Taumata Rau tētahi utauta rorohiko rerekē mō te ako i ngā rerekētanga ā-ira e pā ana ki te pūtake o te porohau.

He momo kaikōiwi kakātanga mamae te porohau e tino nui rawa te pā ki ngā taupori Māori me Te Moananui-a-Kiwa. Ka pupū ake ina tipu ngā tioata uriki i roto i ngā hono, ā, ka pā mai mēnā he nui te uriki i roto i te toto. Nā ngā rerekētanga iranga i waenga i te tangata ka pā mai ngā rerekētanga ki te nui o te uriki, e whai pānga ana ki te tūpono pā mai o te porohau ki ia tangata. Mā te matapae i te nui o ngā uriki mai i te hanganga ira o te tangata ko te mutunga atu ka pai ake ngā putanga hauora mō te hunga e pāngia ana e te porohau. I whakamahia e ngā kairangahau i rangahau i tēnei raruraru i mua tētahi tikanga tatauranga tino kaha e kīia ana ko te rangahau huingaira-whānui hāngai. Engari, ka matapaetia te whāititanga ō tēnei tikanga e tino whakamahia ana.

He auahatanga o nā tata nei ngā tauira kōtuinga io hōhonu ā-aronga i tutuki te whakamahi mō ētahi o ngā raruraru uaua rawa o te koiora rorohiko (hei tauira, te āhukahuka atahanga me te matapae i te hanganga pūmua). I tēnei takuhe Tahua Marsden Arowhānui, ka whakaritea e Ahorangi Tuarua Gavryushkin rāua ko Ahorangi Witbrock tētahi rōpū kei roto ko **Tākuta Megan Leask** (Kāi Tahu, Kāti Mamoe), **Tākuta Karaitiana Taiuru** (Ngāti Tahu, Ngāti Kahungunu, Ngāti Toa), me **Ahorangi Tony Merriman** ki te waihanga i kaupapa ā-aronga ki ngā rangahau huingaira-whānui hāngai. Kātahi anō te momo kaupapa pēnei ka hōpara i te wāhanga o ngā tauwhitiwhiti iranga ki te mate. Ka whakangungu te utauta hou me tētahi huingararaunga porohau nui mai i Piritana Nui, ka tāpirihia ki te taha o ngā raraunga mai i ngā tāngata Māori me Te Moananui-a-Kiwa tokoiti ake. Ka hangaia ngā tikanga hei whakakore i ngā whakaaro tītaha kei ngā raraunga, ā, i te mea ko ngā raranga ira he whakapapa, ko ngā tikanga ka ārahi i te mahi a te rōpū. Ka tino whai wāhi mai ngā whānau, ngā hapū me ngā iwi i roto i te whakamāoritanga o ngā raraunga.

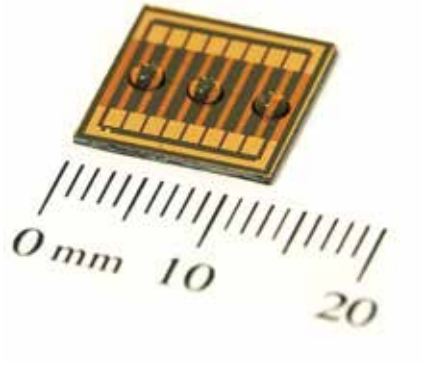
Ka tautoko te kaupapa i te whāinga pae tawhiti o te waihanga i te utauta hāngai whānui ka taea te whakamahi mō ngā mate maha rerekē. Mā te whakamōhio haere i te whakamaimoatanga me ngā tātari mō te Māori me Te Moananui-a-Kiwa e pā ana ki te porohau, ka tautoko te rangahau a te rōpū i te whai wāhi ōrite ki ngā ratonga ira.

HOW THE NOSE KNOWS

UNDERSTANDING THE MECHANISMS OF OLFACTORY RECEPTORS

Dr Natalie Plank, Te Heranga Waka –Victoria University of Wellington, is leading a team to use a novel biosensor to investigate the structure and mechanism of insect odour receptors.

Dr Natalie Plank in the lab.
Image: VUW. A carbon nanotube field-effect transistor (FET).
Image: Erica Cassie



Insects thrive in diverse ecological niches partially because of their unique odorant receptors (ORs) – a class of proteins specialised for odour detection. Insect odorant receptors are exquisitely sensitive, being able to detect single molecules. They can also detect a wide range of chemicals, making them an ideal candidate for artificial nose technologies. Previous research has shown that insect ORs contain two different components: one that binds chemicals, and another called Orco that generates the signal. These components work together to bind odour molecules and then to generate and transmit a specific signal across cell membranes. However, the complete structure and mechanism of these receptors remains a mystery.

Dr Plank and **Dr Colm Carraher**, Plant & Food Research, recently developed highly sensitive electronic sensors, where olfactory receptors were inserted into lipid bilayers, simulating a cell membrane, and then immobilised on carbon nano tubes and graphene field-effect transistors. They were surprised to find that the Orco component was not required for sensing – exposing the limitations of our current understanding of how these receptors transmit signals. Dr Plank, Dr Carraher and **Dr Adam Micolich** from the University of New South Wales have been awarded a Marsden Fund Standard grant to pin down exactly how these olfactory receptors generate a signal, using their novel biosensor. They will combine precision molecular biology tools with nanoelectronics to investigate exactly how the binding of a chemical triggers signal transmission. The team's research will answer fundamental questions of how olfactory receptors function and will also advance their potential use in artificial nose technologies.

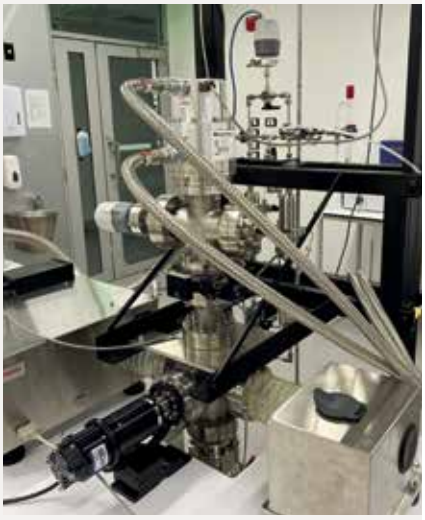
SIGNS OF LIFE

CAN THE BUILDING BLOCKS OF LIFE BE FOUND ON SATURN'S LARGEST MOON, TITAN?

Dr Courtney Ennis, University of Otago, and team are exploring whether the building blocks of life can form in the atmosphere of Titan, Saturn's largest moon.

In 2027, the NASA/Johns Hopkins *Dragonfly* spacecraft will embark on a journey to Titan. Titan's environment resembles the very early Earth and *Dragonfly* will scour its surface in search of complex organic molecules. Astrobiologists are predicting they will find multi-component crystal minerals – 'co-crystals' – which could facilitate chemical reactions to create biologically-important compounds like the elementary units of DNA.

Dr Ennis has assembled an international multidisciplinary team for this Marsden Fund Standard project to explore how these Titan co-crystals could generate life's building blocks. They have established a new laboratory setup at the University of Otago which mimics the icy surface, atmospheric aerosols, and radiation environment of Titan. Under these conditions co-crystals are expected to form some of the organic chemicals necessary for life to develop. From this, Dr Ennis's team will be able to offer the *Dragonfly* mission some molecular clues as to what it will find across Titan's frozen tundra. This project has exciting implications for the field of astrobiology as well as the deeper human questions around the origins of life on Earth and the prospect of extra-terrestrial life.



Dr Courtney Ennis and the Titan surface astrochemistry experiment that will be used in this research.

Whatungarongaro te tangata, toitū te whenua
As man disappears from sight, the land remains

Nevis Valley (stock image, Rob Brown)

HOW TO DIE A CULTURALLY, SOCIALLY, AND ENVIRONMENTALLY SUSTAINABLE DEATH IN AOTEAROA

TWO UNIQUE MARSDEN FUND STANDARD PROJECTS FOCUS ON WHAT HAPPENS TO OUR BODIES ONCE WE LEAVE THE PHYSICAL WORLD BEHIND.

Professor Hinematau McNeill, Auckland University of Technology, is setting out to test a belief that urupā tautaiao (natural burials) are affordable, culturally empowering for Māori, and environmentally sustainable.

Associate Professor Ruth McManus, University of Canterbury, is especially concerned with body disposal and the impacts on the environment, aiming to pull together a variety of local knowledges in green innovation – including Māori – to develop a climate change adaptation strategy.

One thing certain about life is that we all die. With this certainty comes the customary duty of organising farewells to and final preparations of the dead. While these rites and rituals vary across times and cultures, so do forms of body disposal – whether the deceased is earth-buried, sea-buried, sky-buried or cremated, and whether remains are buried forever, placed in vaults or scattered. These practices are important for both people and place.

Professor McNeill and her team are adopting a decolonising agenda in their exploration of death practices for their Marsden Fund Standard project. By prioritising mātauranga Māori (Māori knowledge), this project provides an opportunity for Māori to re-evaluate and reconnect with their ancient customs and practices. Working alongside iwi, researchers will facilitate several hui, conduct environmental monitoring, archival research, and interviews to understand the potential of tangihanga (customary funerals) today and urupā taiao (natural burials) for living wellbeing in terms of Māori connection to, and responsibility for, the natural world.

Associate Professor McManus and her team have been awarded a Marsden Fund Standard grant to address the issue of our current funeral, burial and cremation systems. Current systems pollute, are environmentally unsustainable, and are reaching capacity in Aotearoa. While some individuals, businesses, organisations and local governments are investigating and investing in more sustainable options, they are limited in reach and impact. Using network analysis that maps strategies of sustainability across the country, this project sets out to integrate local knowledges to connect up death practices, processes and infrastructure that can move us to a reduction in Aotearoa's carbon footprint.

Death and bereavement can be a challenging and demanding time for whānau and friends of the deceased. The remains of the person must then be disposed of, contributing to a negative environmental impact on our planet. These innovative projects by McNeill and McManus are leading the course in exploring the ways we can create lasting connection and legacy with culture, people, and planet.

Professor Hinematau McNeill delivering a presentation at Moko Marae, Te Puke, 2021 Right: Associate Professor Ruth McManus

Research site Haparangi A2, with Māori Land Court authorisation (2021) to establish a natural burial urupā on the land

Professor Hinematau McNeill and post graduate student Kathleen Frewen

ME PĒHEA TE MATE I RARO I NGĀ TIKANGA AHUREA, PĀPORI, TIAKI TAIAO HOKI I AOTEAROA

E RUA NGĀ TAKUHE TAHUA MARSDEN AROWHĀNUI AHUREI KO TE KAUPAPA HE TIROTIRO KA AHATIA Ō TĀTAU TINANA INA WEHE ATU TĀTAU KI TUA O TE ĀRAI.

Kua tahuri a **Ahorangi Hinematau McNeill** mai i Te Wānanga Aronui o Tāmaki Makaurau ki te whakamātautau i tētahi whakapono ko ngā nehunga māori he whaiutu, he whakamana i ngā tikanga Māori, ā, he pai mō te taiao.

Kei te tino māharahara a **Ahorangi Tuarua Ruth McManus** o Te Whare Wānanga o Waitaha ki te putunga tūpāpaku me ngā pānga ki te taiao, e whai ana ki te whakakotahi mai i ngā tūmomo mōhio o te motu mō ngā auahatanga ā-taiao – me ā te Māori – ki te waihanga i tētahi rautaki urutaunga huringa āhuarangi.

Ko tētahi āhuatanga tūturu ka mate tātau. Nā tēnei mea tūturu ko ngā tikanga o te whakariterite i ngā poroporoaki me ngā whakaritenga whakamutunga mō te mate. Ahakoa he rerekē ēnei kawa me ēnei tikanga i roto i ngā wā me ngā ahurea, he pērā anō te whakawātea i te tūpāpaku – ahakoa he mea tāpuke ki te oneone, ki te moana, ki te rangi, ka tahuna rānei, ā, mēnā ka noho tāpuke tonu ngā mahuetanga mai mō ake tonu, ka raua ki ngā toma, ka ruiruia rānei. He mea hira ēnei tikanga mō te tangata me te wāhi.

Kei te whai a Ahorangi McNeill me tōna rōpū i tētahi kaupapa wetewete i te Whakapākehātanga i roto tana hōpara i ngā tikanga mahi mō tā rātau kaupapa Tahua Marsden Arowhānui. Mā te whakatau he mea matua te mātauranga Māori, he whai wāhitanga tēnei kaupapa mō te Māori ki te whakaaroaro anō me te tūhono anō ki ā rātau tikanga tuku iho. Mā te mahi i te taha o ngā iwi, he maha ngā hui ka whakahaerehia e ngā kairangahau, te aroturuki i te taiao, ngā rangahau pūranga kōrero, me ngā uiui kia mārama ai ki ngā mea ka taea i ngā tangihanga i ēnei rā me ngā nehunga māori mō te oranga o te noho e ai ki te hono, ngā herenga hoki o te Māori ki te ao tūroa.

Kua whakawhiwhia a Ahorangi Tuarua McManus me tōna rōpū ki tētahi takuhe Tahua Marsden Arowhānui ki te whakarite i te take mō ā tātau whakahaere tangihanga, tāpuke me te tahu onāianei. Ko ngā whakahaere onāianei he tānoanoa i te taiao, ā, kua eke haere ki tōna whānuitanga i Aotearoa. Ahakoa e rangahau ana, e haumi ana ētahi tāngata, pakihi, whakahaere me ngā kaunihera ki ngā ara toitū ake, he whāiti noa iho, he whāiti te pānga. Ma te whakamahi i te tātari i te kōtuinga e whakamahere ana i ngā rautaki toitūtanga puta noa i te motu, e whai ana tēnei kaupapa ki te whakakotahi mai i ngā mōhio paetata kia tūhonohono i ngā tikanga mate, ngā tukanga me ngā hanganga e taea ai e tātau te whakaiti te pānga waro o Aotearoa.

He wā uaua, he wā taumaha te mate me te tangihanga mō ngā whānau me ngā hoa o te tūpāpaku. Me mātua whakawātea te tūpāpaku o te tangata, e pā kino ana ki te taiao o tō tātau ao. Kei te ārahi ēnei kaupapa auaha a McNeill rāua ko McManus i te ara mā te hōpara i ngā tikanga e taea ai e mātau te tuitui hononga pūmau, tuku iho hoki me te ahurea, iwi me te Papatuānuku.

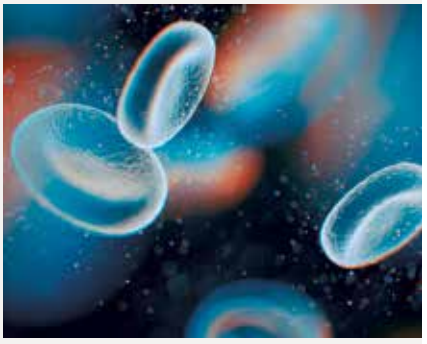
Whatungarongaro te tangata, toitū te whenua

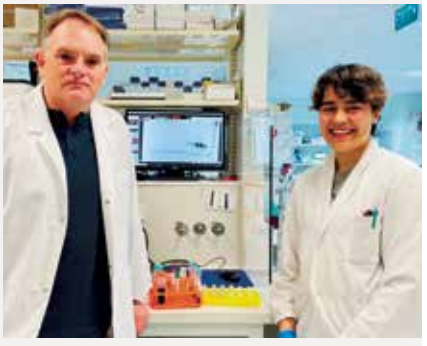
HOW FAST ARE YOU AGEING?

Working with blood samples from volunteers, Professor Mark Hampton, University of Otago, will study human ageing.

Ageing is a major risk factor for many human diseases, but there is limited information on the underlying biochemical and molecular processes involved. A common feature of metabolism is the everyday transfer of electrons to oxygen, generating reactive oxygen species that damage our cells. Oxidative damage accumulates in aged tissues, but it is unclear if this damage is a cause or a consequence of ageing. While studying blood samples from healthy middle-aged people, Professor Hampton and his team observed an association between the rate at which the red blood cells from these people recovered from an oxidative challenge and how fast the donors were ageing. Professor Hampton has been awarded a Marsden Fund Standard grant to undertake a detailed investigation of the link between human ageing and the ability of our cells to respond to oxidative stress.

Professor Hampton and his team will work with blood donors of different ages to understand the genetic and environmental factors that influence how quickly proteins called peroxiredoxins inside red blood cells return to their normal state after exposure to oxidative stress. Peroxiredoxins are found in many organisms – including humans – and are thought to be central to the response of cells to oxidative stress. Red blood cells may be valuable predictors of how fast other cells in the body are ageing, and provide a window into what is happening at a molecular level. This study is one of the few that is taking a close look at fundamental processes associated with human ageing prior to the emergence of age-related disease.





Professor Hampton and PhD student Te-Rina King Hudson who will work on this project

SUBMARINE SUPERHIGHWAYS

TRACKING THE DEEP-SEA BURIAL OF ORGANIC CARBON

Dr Katie Maier and Dr Scott Nodder from NIWA, with a team from GNS Science and Oxford University in the UK, will investigate the importance of large deep-sea canyons for the transport of carbon from land into the deep sea and eventual burial under the seafloor.

Dr Scott Nodder, Dr Katie Maier, and Cathy Ginnane at the Rafter Radiocarbon Laboratory, GNS

Concealed beneath the waves, sediment and organic carbon from land and shallower waters are funnelled along deep submarine canyons, resulting in the burial of carbon in seafloor deposits. This carbon burial helps to offset the effects of climate change by reducing how much carbon circulates. Although the deep sea is one of Earth's largest sinks of atmospheric carbon dioxide, the significance of these land-to-deep-sea highways as a sink in global carbon budgets remains unclear. Forming part of the equation are large 'canyon-flushing' events, rare phenomena which can be triggered by earthquakes. It's currently unknown if they play a bigger role in concentrating carbon into the deep sea than the more frequent smaller events and day-to-day sediment flows through canyons and channels.

Dr Maier and Dr Nodder, along with their research team, have been awarded a Marsden Fund Standard grant to tap into a unique opportunity to investigate the importance of large canyon-flushing events in organic carbon transfer from land into the deep sea. They will be focusing on the 2016 Kaikōura earthquake, which resulted in a massive canyon flushing event that happens every one to two hundred years in the Kaikōura Canyon and Hikurangi Channel, off the east coast of the South Island. Using innovative deep-sea methods, the research team will sample and measure near-seafloor flows and their sedimentary deposits. A key aspect of their project will be the use of novel radiocarbon analyses to reveal where the carbon originated from and how much new carbon has been buried.

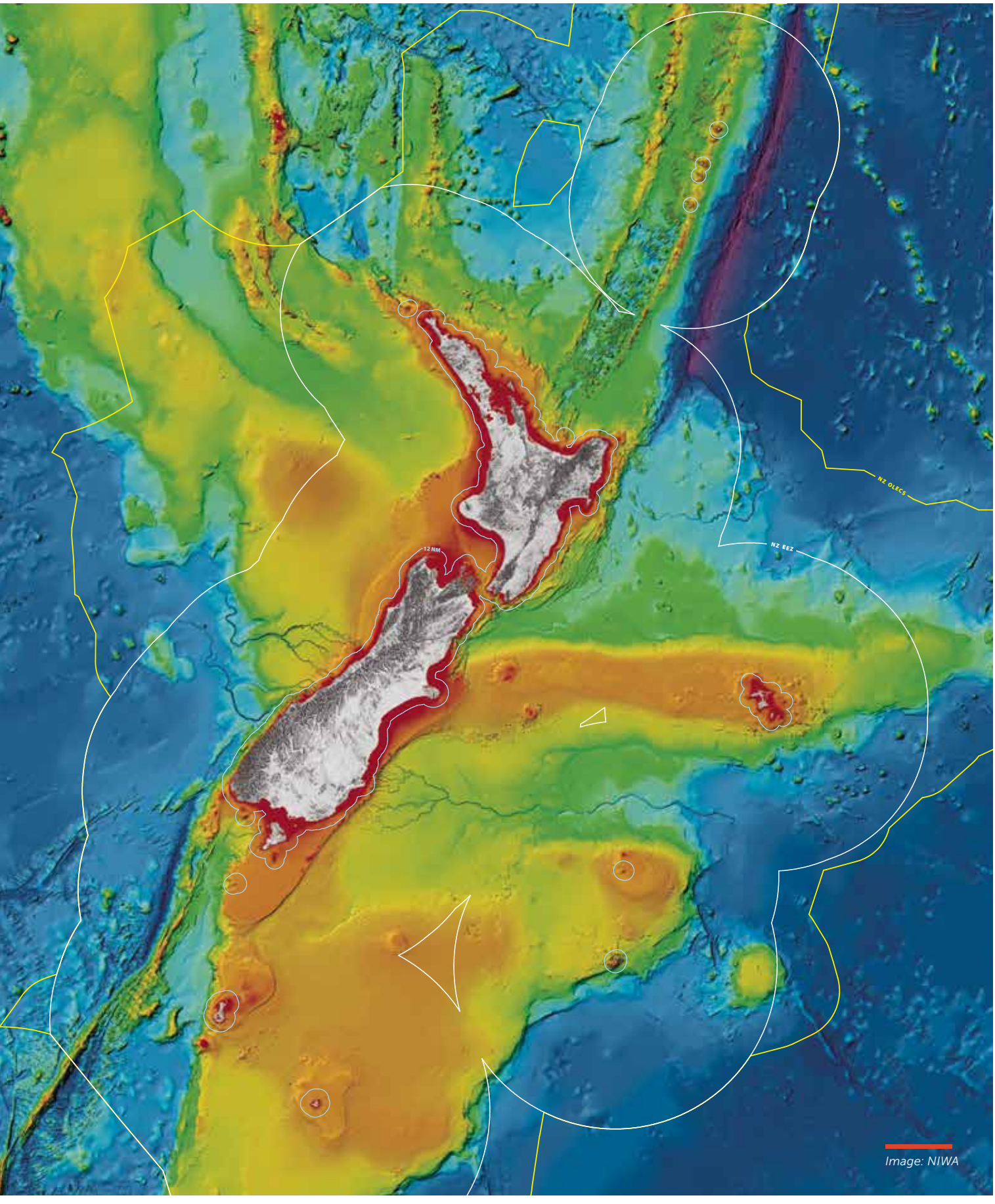


Image: NIWA

Associate Professor Vanholsbeek and Dr McGoverin in the laboratory

FINDING THE RIGHT TOOLS

TO UNDERSTAND THE JOINTS THAT KEEP US GOING

Associate Professor Frederique Vanholsbeeck, University of Auckland, and team are exploring how joint tissues, the stuff that supports our bones, alter under the weight of everyday life.

Weight-bearing soft tissues, commonly called joint tissues, are a vital component of daily life, powering all sorts of body movement. How joint tissues degrade and under what conditions is difficult to predict. Current research and diagnosis methods for joint tissue problems mostly involve imaging methods like ultrasound and MRI. These methods do not investigate the mechanical properties of joint tissues, which is critical for prognosis of joint issues.

Associate Professor Vanholsbeeck has been awarded a Marsden Fund Standard grant to develop a 'mechano-structural' assessment system for understanding the physiology of joint tissue – particularly articular cartilage. Articular cartilage, which is the cartilage supporting bone movement, is severely affected in patients with osteoarthritis, a crippling disease that disproportionally affects Māori and costs Aotearoa New Zealand six billion dollars annually. There is no known cure, and current treatments are limited to pain relief, physiotherapy and joint replacement surgery. Thus, early diagnosis of osteoarthritis is very important, but impossible through conventional diagnostic tools.

Associate Professor Vanholsbeeck and her team will monitor both healthy and diseased tissues under everyday life loads using their in-house imaging tools which visualise tissue at different scales that range through what can be perceived by the naked eye to the cellular and molecular levels. From these studies, they will develop a model of tissue degeneration which will support the development of a Swiss Army style tool allowing the practical monitoring of joints with both keyhole imaging and a force sensing probe to assess the mechanical functioning of joints. This tool will allow medical professionals to monitor joint health and detect injury at very early stages, helping to keep us active and healthy for longer.

Close up of eroding midden deposit, Coromandel Peninsula. Image: Louise Furey

WĀHI TUPUNA

USING MARINE SHELLS TO ACCURATELY LOCATE EARLY MĀORI SETTLERS IN TIME

Associate Professor Fiona Petchey, University of Waikato, is constructing a precise and detailed picture of the past, using carbon dated shells from Te-Moana-Nui-a-Kiwa, the Pacific Ocean.

Early stages of Māori settlement remain unclear because environmental records, archaeological excavations, and Māori histories have not been aligned in terms of chronological time periods. Currently, the established cultural sequence for the Māori settlement of Aotearoa is divided into three tiers starting with the East Polynesian settlement, a transitional period of habitation and expansion, followed by the time of the 'Classic' Māori as described by European explorers. However, archaeological evidence and iwi histories indicate that the settlement process was far more complex. The three-tier structure provides few links with the traditionally recorded events that shaped Māori culture and tells us little about environmental adaptation, socio-political development, material culture changes, or social connectivity. This poor understanding of how time has shaped behaviour has resulted in conflicting interpretations of Aotearoa's past.

Associate Professor Petchey and her team of archaeologists and anthropologists – **Dr Louise Furey** (Auckland War Memorial Museum), **Dr Gerard O'Regan** (Otago Museum), **Professor Atholl Anderson** (Independent Researcher), and **Dr Magdalena Schmid** (University of Kiel, Germany) – aim to change this. In their Marsden Fund Standard grant they will use radiocarbon dating of the remains of marine shellfish left by Māori ancestors to dramatically sharpen our view on pre-European Aotearoa. Radiocarbon is an isotope of carbon naturally found in all plants and animals. After death, radiocarbon very gradually decays away, and the amount left can be used to estimate the age of the animal or plant remains. This project goes beyond conventional radiocarbon methodologies by combining archaeological materials from the land, and sea – enabling the team to observe more linkages between people and environmental changes.

By using marine shells, the team can find out more details about the way people moved around and develop timelines that provide understanding of natural and human effects on island ecosystems.

This research will provide insights into how quickly human societies in Aotearoa dealt with environmental differences and adapted to long-term climate deterioration. Improved dating of marine shells – the most abundant material found in coastal dumping sites – will provide more scientific and contextual information that will enhance Māori communities' knowledge of wāhi tupuna (ancestral places) throughout Aotearoa. The information gained will provide a more detailed template of change that can be used to explore both the visible footprint and Māori world views.

Dr Petchey in front of equipment used for radiocarbon dating

WĀHI TUPUNA

TE WHAKAMAHI I NGĀ ANGA MĀTAITAI KIA TIKA AI TE KIMI I TE WĀ O NGĀ KAINOHO MĀORI O NEHERĀ

Kei te hangaia e Ahorangi Tuarua Fiona Petchey mai i Te Whare Wānanga o Waikato tētahi tirohanga tino tika, āmiki hoki o te ao o nehe, mā te whakamahi i ngā anga whaiwaro hei ine i te wā mai i Te Moananui-a-Kiwa

Kāore tonu i te tino mōhiotia ngā wāhanga tuatahi o te noho a te Māori i te mea kāore i whakahāngaitia ngā whakaaturanga taiao, ngā karinga whaipara me ngā hītori Māori e ai ki ngā wā kua whakaraupapatia. I tēnei wā, ko te raupapatanga tuku iho e mōhiotia ana mō te whakanohotanga a te Māori kua wehe ki ngā wāhanga e toru ka tīmata atu i te whakanohotanga o te haurāwhiti o Te Moananui-a-Kiwa, he wā whitinga o te nohonga me te whakawhānuitanga, whai muri mai ko te Māori 'Tauhira" i kōrerohia e te kaihōpara Pākehā. Engari, e tohu ana ngā whakaaturanga whaipara me ngā hītori ā-iwi he matawhānui ake te āhua o te whakanohotanga. He iti noa ngā hono o te hanganga wāhanga takitoru ki ngā kōrero tuku iho ahuahu ai i te ao Māori, ā, he iti noa ngā whakamārama mō te urutau ki te taiao, te whanaketanga pori-tōrangapū, ngā rerekētanga ā-ahurea, te honohono ā-pāpori rānei. Nā te kūare ki te āhua o te rerekē o te whanonga nā te wā kua tukituki ngā whakamāoritanga mō te ao o nehe o Aotearoa.

E whai ana a Ahorangi Tuarua Petchey me tōna rōpū kaimātai whaipara me ngā tohunga tikanga tangata – **Tākuta Louise Furey** (Tāmaki Paenga Hira), **Tākuta Gerard O'Regan** (Te Whare Taoka o Ōtākou) **Ahorangi Atholl Anderson** (Kairangahau Motuhake), **Tākuta Magdalena Schmid** (Te Whare Wānanga o Kiel, Tiamana) – ki te takahuri i tēnei. I roto i tā rātau takuhe Tahua Marsden Arowhānui ka whakamahia e rātau te inewā horowaro o ngā mahuetanga mai o ngā angaanga mātaitai i whakarērea mai e ngā tīpuna Māori kia tika ai tā tātau titiro ki a Aotearoa i mua o te taenga mai o te Pākehā. Ko te inewā horowaro he kanoirite o te waro e kitea ana i roto i ngā tipu me ngā kararehe katoa. I muri i te matenga, ka pīrau haere te horowaro i roto i te wa, a, ko te rahinga ka toe mai ka taea te whakamahi hei whakatau tata te tawhito o ngā mahuetanga mai o te kararehe, tipu rānei. Kei tua kē atu te kaha o tēnei kaupapa i ngā tikanga inewā horowaro noa, arā, mā te whakakotahi i ngā rauemi whaipara mai i te whenua, me te moana – e taea ai e te rōpū te tirotiro i ētahi atu hono i waenga i ngā huringa ā-tangata, ā-taiao hoki.

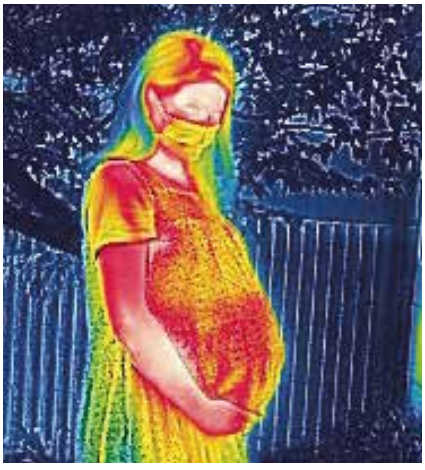
Mā te whakamahi i ngā angaanga kaimoana, ka kitea e te rōpū ētahi atu taipitopito mō te āhua o te nekeneke haere a te tangata me te waihanga i ngā wā e mārama ai ki ngā pānga tūturu, ā-tangata hoki ki ngā pūnaha rauropi o te motu. Ka tukuna e tēnei rangahau ko ngā tirohanga ki te tere o te whakarite a te tangata ki ngā rerekētanga o te taiao me te urutau ki te tupuheke āhuarangi wā roa. Mā te pai ake o te inewā i ngā angaanga mātaitai – ko ngā matū e tino kitea ana i ngā wāhi putunga i tātahi – e puta ai ngā mōhiohio pūtaiao me te horopaki mārama ake ai ngā mōhiotanga o ngā hapori Māori ki ngā wāhi tūpuna puta noa i Aotearoa. Ka puta mai i ngā mōhiohio ka riro mai ko tētahi tauira āmiki ake o ngā rerekētanga ka taea te whakamahi hei hōpara i ngā tapuwae me ngā tirohanga a te Māori. Ka whakatenatena tēnei kia nui ake te whakamahi i ngā utauta me ngā mōhiotanga o nā noa nei kia hāngai ake ngā kitenga whaipara ki ngā tikanga tuku iho.

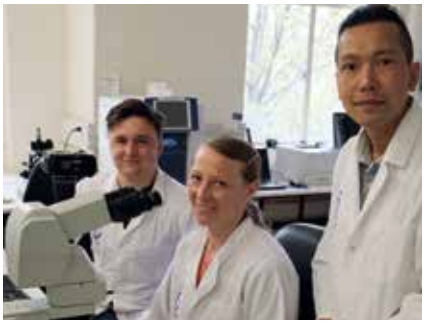
Image: Louise Furey

COOLING FOR TWO

THE NEURONS KEEPING PEOPLE COOL DURING PREGNANCY

Dr Sharon Ladyman, University of Otago, will investigate if warm-sensitive neurons regulate core body temperature during pregnancy.





Pregnancy thermal image (supplied), and Dr Sharon Ladyman and team

If you have ever been pregnant in summer, you will likely appreciate that pregnant people need a way to cool down. We know that pregnancy increases core body temperature, due to hormonal changes and increased metabolic load as pregnancy advances. Since increases in body temperature can be detrimental to foetal development, there must be a way to offset this rising heat, but the mechanism in the body which does this has not been identified yet.

An area of the brain involved in reducing core body temperature has only recently been discovered which could provide some insight. These warm-sensitive neurons are stimulated by increases in environmental temperature, and in turn cause a rapid reduction in core body temperature. However, how warm-sensitive neurons regulate core body temperature in normal physiological contexts has yet to be determined.

Dr Ladyman and her team have recently made the exciting discovery that a proportion of these warm-sensitive neurons have receptors for the pregnancy hormone prolactin. The team have been awarded a Marsden Fund Standard grant to investigate whether prolactin can make warm-sensitive neurons more sensitive in their response to raising body temperature during pregnancy. They will study this effect in mice to investigate the consequences for the health of the pregnancy and subsequent milk production. This work will provide novel insight into regulation of core body temperature and demonstrate a key physiological function of these recently identified warm-sensitive neurons. The results of this study may have important implications, such as sustaining healthy pregnancy and good levels of milk production in warmer climates.

04 /
MARSDEN FUND FAST-START GRANTS

POST-PANDEMIC PASIFIKA

REBUILDING RESILIENT AND SUSTAINABLE SOUTH PACIFIC TOURISM

Fijian researcher Dr Apisalome Movono, Massey University, is exploring how South Pacific people involved in tourism have been impacted by Covid-19 and how they are responding. From lessons learned, the project will consider how tourism can be reimagined in more sustainable and equitable ways.

Aerial views of Vatuolalai village and the Naviti Resort, Western Fiji – a study site for the project, and Dr Apisalome Movono

The global pandemic has led to the near collapse of the international tourism industry. The Pacific islands, in particular, are in financial pain, experiencing a $950 million decline in the regional economy. Yet the pandemic also provides an exciting opportunity for re-building tourism practices in a more sustainable and resilient way.

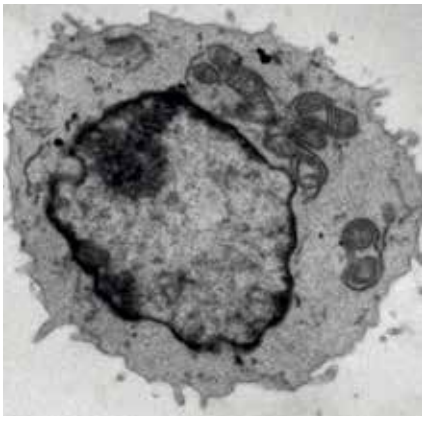
Despite this unique chance for change, there are commonly held expectations of 'bouncing back' to a previous state of economic normality after a shock like the pandemic. This view is prevalent in global predictions of post pandemic tourism, which presume that 'resilience' simply means returning to 'the way things were'. So far, little consideration has been given to the opportunity to reset and reorganise the tourism system to withstand a diverse range of shocks.

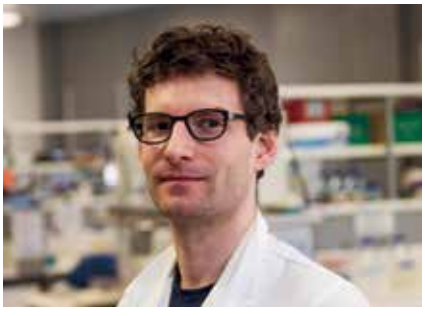
Pacific peoples have adjusted their livelihoods and maintained essential food production and social safety nets in response to crises in the past. Dr Movono's preliminary research has shown those who have lost tourism income due to the pandemic are already using a variety of similar adaptive measures. By using a participatory, inclusive, and decolonised action-based research approach, his Marsden Fund Fast-Start project will expand theoretical models in Pacific tourism resilience research and generate meaningful and concrete actions for tourism that can withstand future uncertainties and shocks. The study looks to challenge colonial and capitalist views that tourism must return rapidly to the status quo, by taking a new path and drawing on Indigenous knowledge systems to inspire innovation.

THE DOUBLE-EDGED SWORD OF FEVER

CAN IT GET TOO HOT FOR OUR T CELLS?

Dr David O'Sullivan, Malaghan Institute of Medical Research, will determine the impact of fever on immune cell function during infections.





Electron micrograph of an activated T cell. Dr David O'Sullivan

Fever is a common symptom in many infectious diseases. Previous research shows that the increased temperature associated with fever can directly impair viral and bacterial replication, helping us to overcome viruses and infections. However, the specific impacts fever has on the body's own immune system are not well understood.

Dr O'Sullivan has been awarded a Marsden Fund Fast-Start grant to examine the impact of fever on the immune system during infectious disease. Fever, it turns out, might be a double-edged sword. Dr O'Sullivan has shown that fever improves the ability of immune system T cells to become activated, which helps them to fight infection. Once infection is cleared however, ongoing fever may compromise the ability of T cells to remember and re-engage with the same germs in the future. The work of this project will be to probe this double-edged relationship in greater detail across a range of infectious diseases. Dr O'Sullivan will then be able to draw conclusions on how the T cell's response, physical characteristics, and survival are altered by fever.

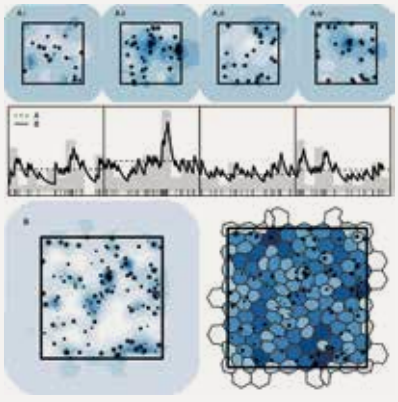
Ultimately this work will develop a better understanding of how fever could be modified to maximize the efficiency of our body's immune system, for example by raising the temperature using heat packs, or lowering temperature using ibuprofen or paracetamol, as appropriate. Apart from developing our fundamental knowledge of human biology, this project could help improve outcomes for patients with infectious diseases such as Covid-19.

CAN WE PREDICT THE UNPREDICTABLE WITH STATISTICS?

From viral tweets to earthquake aftershocks, Dr Charlotte Jones-Todd, University of Auckland, and her team are creating new statistical models designed to shed light on why these things happen and what could happen next.

Some events begin or are caused by underlying processes that we can't control or even know in hindsight – a tweet goes viral, an earthquake induces an aftershock, a routine flight disappears. Taking a bird's eye view, we see events normally play out as a chain reaction of phenomena. Establishing how events interrelate in the chain reaction – how they are linked in terms of time and space – is vital for fields like disaster planning where lives depend on accurate information.

To model such interrelationships is a complex problem requiring sophisticated statistical modelling. Dr Jones-Todd has been awarded a Marsden Fund Fast-Start project to develop new statistical frameworks for modelling events. The models created will incorporate self-exciting behaviours, which are when the presence of one event makes another event more likely. The combination of both event interrelationships and self-exciting behaviour will make the models practical and adaptable. The mathematical frameworks created over the course of this project could see use in a range of different fields from ecology to epidemiology and everywhere in between.



Spatiotemporal point process models with different temporal structures. Model (A) assumes constant temporal intensity for each aggregated time interval; Model (B) fits a self-exciting temporal intensity

Dr Charlotte Jones-Todd

PRESERVING TAONGA

DO SOME KUKU HOLD THE KEY TO CLIMATE CHANGE SURVIVAL?

Dr Nathan Kenny (Ngāi Tahu, Te Ātiawa), University of Otago, will explore the resilience of kuku (also known as kūtai or green-lipped mussels) to climate change to assist conservation and aquaculture efforts.

Dr Nathan Kenny

Kuku (green-lipped mussels) are found around the coasts of Aotearoa. As kaimoana, this native species is of great cultural value and supports a $500-million-dollar industry employing over 3,000 people. Kuku also play a fundamental role in the food webs of their aquatic ecosystems. Unfortunately, they are under threat from the temperature extremes and ocean acidification associated with climate change. Heat waves have been known to kill large numbers of adult kuku and environmental stressors also have detrimental effects on the development of juvenile kuku. Since kuku farming relies almost entirely on wild-caught seed stock, climate change could lead to both economic and ecological disaster.

Some individual kuku are more resilient to environmental stresses than others, but it is unknown exactly why this is. Dr Kenny has received a Marsden Fund Fast-Start grant to investigate the gene expression patterns that drive climate change resilience in kuku. This study will employ cutting-edge 'single cell transcriptomic sequencing', which is able to measure gene expression at the single-cell level, allowing for greater ability to study cellular differences. This mahi will enable Dr Kenny to discover the exact differences in early development between resilient and more vulnerable wild kuku. The results of this study will guide best practice in the management of this economically, environmentally, and culturally taonga species and will yield insights into how shellfish respond to global climate change.

TE TIAKI TAONGA

KEI ROTO I NGĀ KUKU TE ORA O TE HURINGA ĀHUARANGI?

Ka hōpara a Tākuta Nathan Kenny (Ngāi Tahu, Te Ātiawa), mai i Te Whare Wānanga o Ōtakou, i te pakaritanga o te kuku (he kūtai tētahi atu ingoa) ki te huringa āhuarangi hei āwhina i ngā mapi tiaki taiao me te ahumoana

Kitea ai ngā kuku i ngā takutai moana katoa o Aotearoa. He nui te wāriu ahurea o tēnei momo taketake hei kaimoana, he $500 miriona te wāriu o te ahumahi, ā, neke atu i te 3,000 tāngata whai mahi i Aotearoa. He wāhanga hira tonu tō te kuku i roto i ngā rārangi kai o ngā pūnaha rauropi o te moana. Engari, kei te noho mōrea nā te kaha rerekē o ngā pāmahana me te waikawatanga o te moana e pā ana ki te huringa āhuarangi. E mōhiotia ana he tino maha ngā kuku pakeke i mate i ngā pāmahana wera, ā, he pānga kino anō o ngā raruraru taiao ki te tipu o ngā kuku pūhou. I te mea e whirinaki ana te pāmu kuku ki ngā kākano o te moana, he mate nui pea ka ahu mai i te huringa āhuarangi ki te ohanga me rauropi.

Ko ētahi kuku takitahi he pakari ake ki ngā raruraru taiao tēnā i ētahi atu, engari kāore i te mōhiotia he aha ake. Kua whiwhi a Tākuta Kenny i tētahi takuhe Tīmata Wawe a Marsden hei tūhura i ngā tauira whakaaturanga ira e kōkiri ana i te pakari o te kuku i roto i te huringa āhuarangi. Ka whakamahi tēnei rangahau i ngā 'raupapatanga rārangi rāpoi ngota pūtau kotahi' tino hou rawa, e taea ai te ine te whakaaturanga ira i te taumata pūtau kotahi, kia tino taea ai te rangahau ngā rerekētanga pūtau. Mā tēnei mahi ka taea e Tākuta Kenny te tūhura ngā rerekētanga tika i ngā whanaketanga tōmua i waenga i ngā kuku pakari me ngā mea mōrea ake o te moana. Ka ārahi ngā otinga o tēnei rangahau i ngā tikanga mahi i roto i te whakahaerenga o tēnei momo taonga ā-ōhanga, ā-taiao, ā-ahurea hoki, ā, ka puta ngā tirohanga ki te āhua o te urupare a ngā mātaitai ki te huringa āhuarangi o te ao.

THE CONSPIRACY RABBIT HOLE

WHY DO SOME FALL IN DEEP AND OTHERS CLIMB OUT?

Like many of us, Dr Matt Williams, Massey University has heard it all before – fake Moon landings, climate change is a hoax, Covid-19 was created in a lab. Dr Williams is embarking on a research project to understand what influences people in their decisions to believe, or not to believe.

Dr Matt Williams. Image: Matt Brown

Conspiracy theories are attempts to explain significant events as the result of secret plots by powerful individuals or organisations. Sometimes institutions do conspire in ways that cause harm, and therefore the public's tendency to consider conspiracies is justified and important. However, the spread of beliefs in unfounded conspiracy theories can have extremely serious consequences, as seen in the January 2021 attack of the US Capitol by rioters who were convinced that the 2020 Presidential election was corrupted by voter fraud. Here in Aotearoa, conspiracy theories about the dangers of 5G technology have provoked the burning of cell phone towers, and continuous misinformation continues to hamper Covid-19 vaccination efforts. Previous research by Dr Williams and his colleagues has found that, at present, approximately half of New Zealanders believe in at least one of 15 unfounded conspiracy theories.

In this Marsden Fund Fast-Start project, Dr Williams brings together a team of combined expertise in political, cognitive, and social-cognitive psychology to launch a first-of-its-kind longitudinal study of participants' responses and descriptions over a two-year period. The study will answer three crucial questions: 1) When a person changes their belief about a conspiracy theory, what reasons do they give for this change? 2) To what extent does belief in one conspiracy theory lead to belief in other conspiracy theories? And 3) Do negative experiences such as stress and depression contribute to belief in conspiracy theories? If we can understand more about why people trip and fall into the rabbit hole in the first place, and determine what it takes for them to choose to climb out, this will ultimately contribute to a more cohesive society; one that includes a healthy dose of scepticism, without the blinding darkness.

SEEN AND HEARD

UNDERSTANDING HOW GIRLS CONSUME, CREATE AND SHARE MEDIA IN AOTEAROA

In today's media, girls encounter high profile girl celebrities who they could potentially see as role models for participating in online media, but they also encounter harassment and abuse – how do they navigate these contrasting experiences? Dr Kyra Clarke, Massey University, aims to find out.

This question is made even more complicated when considering that girls don't just consume media online, they also share and create media in several ways. Each online space allows for some forms of self-expression and engagement, while restricting others. Girls navigate these platforms, negotiating times and spaces where they feel comfortable, where they have a voice, and where they feel shut down. To some extent then, girls are simultaneously shaping the digital world and being shaped by it. How girls participate in their online worlds, and how they experience belonging in these spaces, raises questions around cultural citizenship that are increasingly important in a global media culture.

Seen and heard is the first in-depth study of the media teenage girls consume, create, and share in Aotearoa New Zealand. In this Marsden Fund Fast-Start project, Dr Clarke will seek to understand girls' media practices in 14 to 15-year-old girls and gender diverse youth in Aotearoa, centring their perspectives. Digital diaries, focus groups, interviews, and creative workshops will be interwoven collaboratively with participation from girls, building a comprehensive picture of their perceptions of media participation. Finally, guidelines on how to create inclusive online spaces will be created.

Dr Kyra Clarke. Image Laura Jean McKay

REIMAGINING AN 'HAUTE CUISINE' MATERIAL

CREATION AND CONVERSION OF MOLECULAR INDIUM PHOSPHIDE INTO ITS NANOCRYSTALLINE FORM

Dr Mathew Anker, Te Heranga Waka – Victoria University of Wellington, in collaboration with Professor Michael Hill, University of Bath (UK), is exploring fresh ways to access and control a usually uncooperative material – indium phosphide. If successful, a new generation of renewable energy devices and display technologies could be on the horizon.

The electronic properties of tiny (nanosized) indium phosphide crystals are ideal for next-generation renewable energy devices and TV displays. Combine this potential with indium phosphide's low toxicity and it's easy to see why researchers and companies that make these devices intensely research indium phosphide.

Just like haute cuisine, making good indium phosphide is tricky. Reliably controlling crystal size and purity is a major synthetic challenge. This is because indium phosphide's properties are strongly linked to crystal size and purity. To make indium phosphide crystals you must convert the elements, indium and phosphorus, into a special form.

This Marsden Fund Fast-Start project will create a new combined form of indium and phosphorus, called molecular indium phosphide. Molecular indium phosphide allows the controllable conversion to the crystal form with unparalleled purity and simplicity, just like clicking Lego® blocks together. They will also be able to control the crystal size and therefore its electronic properties. If successful, this research will transform the known capabilities of nanosized indium phosphide, unlocking a whole host of new devices. It will also push Aotearoa further into the huge international community of nanoscale semiconductor research.

Dr Mathew Anker and Tylah Sweet (PhD) working in a glove box on the first generation of molecular indium phosphide

STAYING GROUNDED

RETAINING AMMONIA IN AGRICULTURAL SOIL TO REDUCE GREENHOUSE GASES

Dr Dorisel Torres-Rojas, University of Waikato, will investigate a previously neglected pathway for ammonia retention in soils, with potential to improve soil fertility and reduce greenhouse gas emissions.

Ammonia-based fertilisers are the primary source of nitrogen in agriculture around the world. Some of this reactive nitrogen is transformed in soils and is made available to plants; however, excess nitrogen is leached or converted to gases, including ammonia. This is significant, as ammonia is a precursor of nitrous oxide – a potent greenhouse gas. Strategies to prevent and reduce ammonia emissions are urgently lacking.

Currently, the accepted pathway by which nitrogen is retained in soil is through transformation and retention of nitrogen from ammonia by soil microbes. However, Dr Torres-Rojas, along with a team of researchers from the University of Waikato and the United States of America, has been awarded a Marsden Fund Fast-Start grant to investigate an alternative non-microbial pathway by which ammonia could be incorporated into soil, thereby preventing its release into the atmosphere as ammonia.

Dr Torres-Rojas previously described a novel pathway by which ammonia is bound to a particular type of organic matter, such as charcoal and soot – effectively removing reactive nitrogen from circulation. In this new approach, the research team will ascertain whether the same pathway exists in soil organic matter, which shows similar properties.

They will carry out lab and field studies to determine whether soil organic matter has properties that can bind and stabilise ammonia, thereby acting as a long-term nitrogen sink. To do this, they will establish the capacity of soil organic matter to retain ammonia without the involvement of soil microbes and determine the mechanism by which this occurs, and what this interaction looks like under different environmental conditions. Finally, they will test whether soil organic matter could potentially reduce ammonia emissions in the field.

This research will provide insights into a different reaction mechanism between ammonia and soil organic matter. If ammonia can be retained via this alternative pathway, there is potential to use this interaction to improve nitrogen retention in soils and reduce the discharge of harmful nitrous oxide into Earth's atmosphere.

Dr Torres-Rojas collecting samples with student Leeza Speranskaya, and collecting organic resources, Western Kenya

MOLECULAR TIME-CAPSULES OF OCEANS PAST

RECONSTRUCTING ANTARCTICA'S MARINE ECOSYSTEMS

Dr Gert-Jan Jeunen, University of Otago, with a team from NIWA and Liverpool John Moores University (UK), will reconstruct marine ecosystems of Antarctica's Ross Sea using environmental DNA from marine invertebrate collections.

Marine environments have been exploited throughout human history, leading to habitat degradation and multiple species extinctions. Mitigation and restoration of degraded marine systems is crucial for both economic and ecological reasons. Looking to the past can give us insight into ways to do this. To understand the magnitude of past changes, it is vital to reconstruct what past biodiversity looked like. However, the extent and speed of ecological change in marine ecosystems has rarely been quantified because long-term ecological records are scarce, and accurate historical data difficult and expensive to obtain.

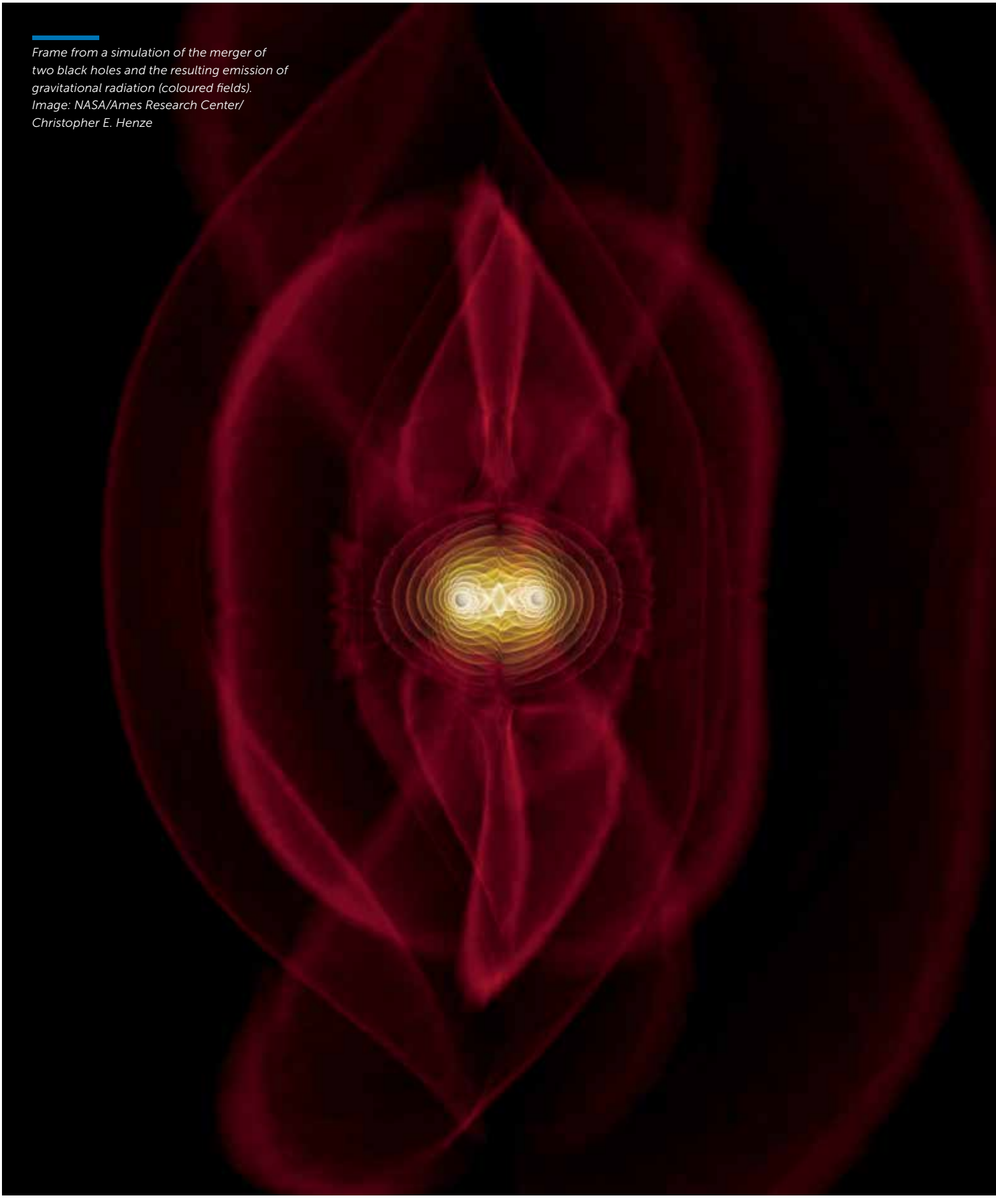
Dr Jeunen and his team have an innovative way to address this. Previously, they showed that several different types of marine filter-feeding organisms accumulate environmental DNA (eDNA) from the sea, which can be used to reconstruct the biodiversity of marine environments. Filter feeders are a group of marine animals, including some fish, ascidians, bivalves, crustaceans and sponges, which feed by straining food particles from water. Vast numbers of these filter feeders have been gathered over centuries and are stored in scientific collections. These archived 'time-capsules' provide a unique opportunity to reconstruct past marine ecosystems. Dr Jeunen has been awarded a Marsden Fund Fast-Start grant to reconstruct the biodiversity of Ross Sea in Antarctica, the second largest marine protected area in the world, using a vast marine sponge collection held by NIWA.

Doubtful Sound sponge: potential ID based on morphology and spicule analysis: Strongylacidon conulosum? Possibly but could be also a Dysidea sp.

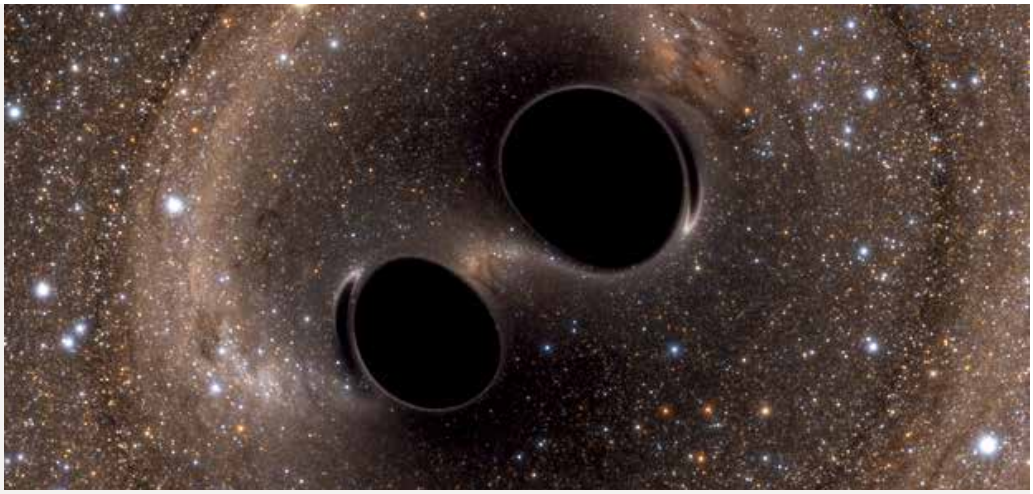
Dr Gert-Jan Jeunen

05 /

RESEARCH UPDATES AND MARSDEN FUND IN THE MEDIA



Frame from a simulation of the merger of two black holes and the resulting emission of gravitational radiation (coloured fields). Image: NASA/Ames Research Center/ Christopher E. Henze



GRAVITATIONAL WAVES

FROM ROTATING BLACK HOLES

Jörg Frauendiener, University of Otago

Ever since **John A. Wheeler** coined the term "black hole" (describing a region of spacetime where gravity is so strong that even light can't escape) in the middle of the last century, they have captured the imagination of students in physics and mathematics. Similarly, the idea of a gravitational wave (disturbances in the curvature of spacetime), postulated by **Albert Einstein** in 1916, has, for a long time remained just that; an idea. However, since September 2015, both of these notions became a reality when LIGO, the gravitational wave detectors developed and built in Germany and the USA, found a signal so large that it could only have been generated by a collision and subsequent merger of two black holes into one.

A lot is known about the interaction of black holes and gravitational waves, however mostly on a "linear level", where the gravitational wave can be considered tiny compared to the black hole. A small wave that effects or "tickles" a large black hole causes the black hole to "ring" like a bell. Like the bell, a black hole emits a spectrum of waves with very characteristic frequencies, except in this case, the waves emitted are not sound, but gravitational waves.

Part of this year's interdisciplinary Marsden Fund Council Award project, **Professor Jörg Frauendiener** has been separately working with **Dr Chris Stevens** and collaborators on a project "Gravitational waves from rotating black holes" to explore "punching" a black hole, by shooting strong gravitational waves onto it and studying the reaction.

This idea has a long history. In the early 20th century, **Sir Ernest Rutherford** with his assistants **Hans Geiger** (Germany) and **Sir Ernest Marsden** (after whom the Marsden Fund is named) blasted gold atoms with alpha particles and studied the resulting scattered pieces. This led Rutherford to postulate that atoms must have very much smaller but massively charged nuclei. All particle colliders that exist today such as the LHC at CERN in Geneva are based on this idea of scattering experiments.

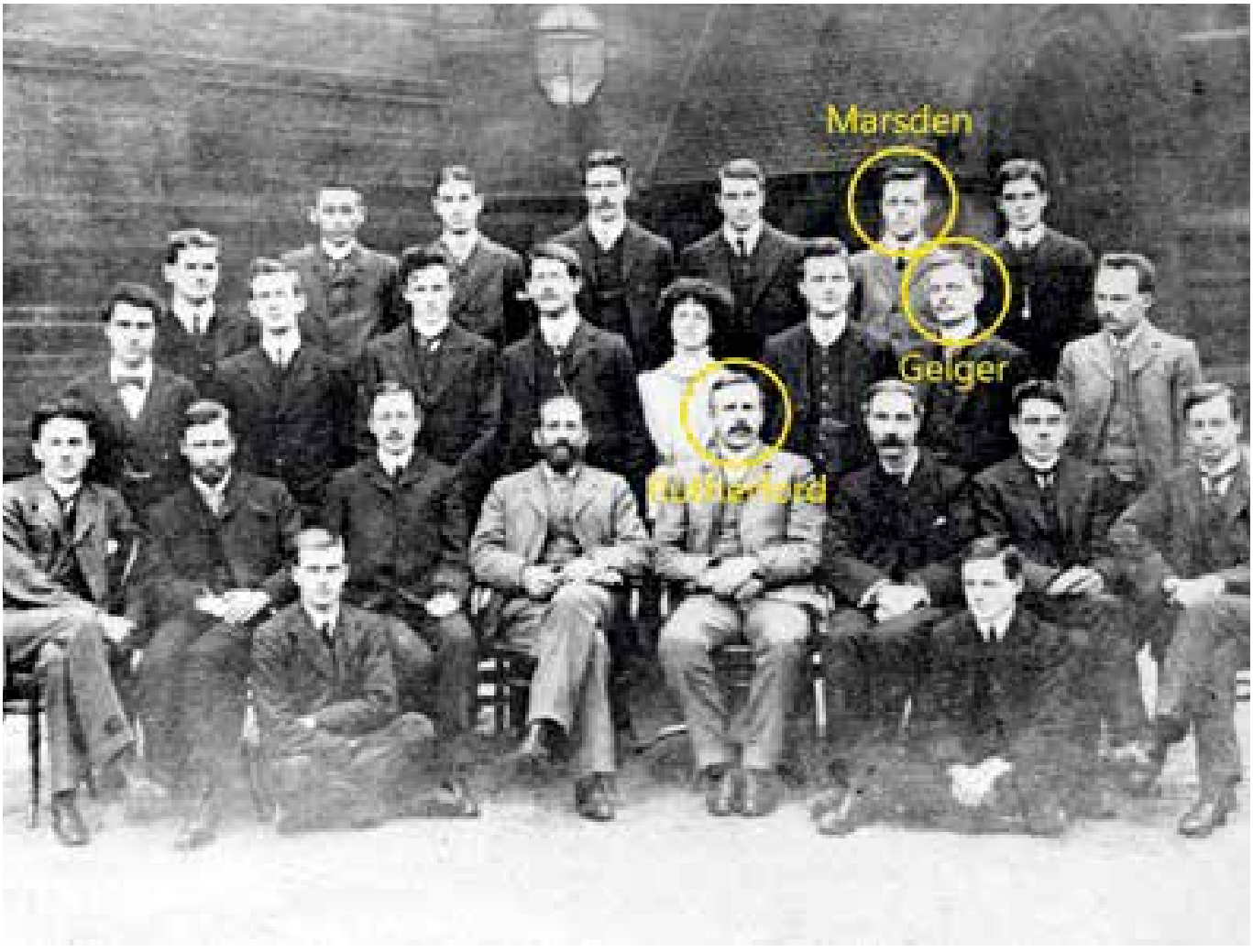
Unlike Sir Ernest Rutherford's experiments, Professor Frauendiener's experiments are carried out virtually by simulating black holes and gravitational waves in a computer. These numerical simulations are based on the equations of general relativity; the theory that describes gravitational interactions of massive objects with gravitational waves. In all scattering scenarios it is important to follow the scattered pieces "to infinity", in other words, for large times and distances. This is difficult in a numerical situation where finite resources preclude long computation times. Therefore, the simulations are done using a "mathematical trick" relating to last year's Nobel Prize winner **Sir Roger Penrose** and his clever geometric procedure; "conformal compactification". This is used to describe the infinite regions of a space-time with a finite sized setting.

The simulations carried out in the Marsden Fund Standard project so far have already provided interesting results. One can see what happens to the ingoing gravitational waves inside the black hole horizon, and how the horizon is deformed by the black holes and the emitted radiation. The next questions to answer about these enigmas are: can one "kick" a black hole like a football, or spin it up like a basketball balanced on the tip of a finger?

To discover more visit Bit.ly/MF57-52

Above: Manchester University Physics Department 1910. Image: J.B. Birks, ed., Rutherford at Manchester

Right: The University of Otago Gravity Group, 2013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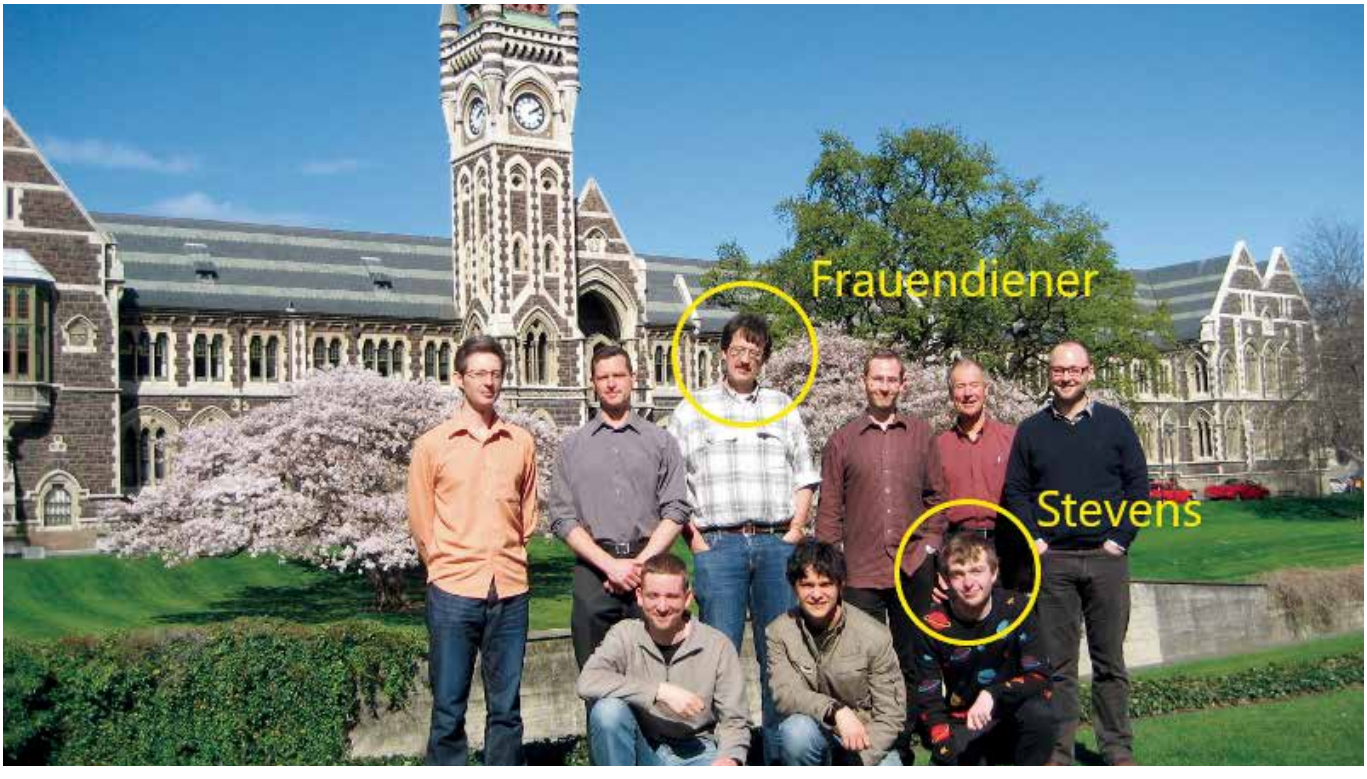
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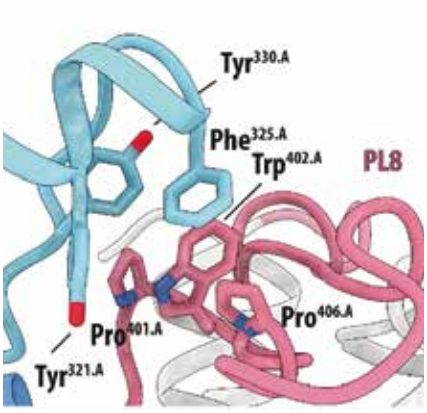
TB RESEARCH WILL MAKE 'ENORMOUS GLOBAL HEALTH IMPACT'

KURT KRAUSE AND GREG COOK, UNIVERSITY OF OTAGO

University of Otago researchers are behind a major scientific breakthrough which could lead to elimination of the world's biggest infectious diseases killer, tuberculosis (TB).



The Otago research team, from left: Assistant Research Fellow Helen Opel-Reading, Professor Kurt Krause, Professor Greg Cook and Research Fellow Dr Kiel Hards, with a computer-generated image of the bd oxidase protein structure. Image: Michele Krause.

Above: extract from figure illustrating Q-loop architecture of cyt. bdMtb.

Professor Kurt Krause and **Professor Greg Cook** are part of an international collaboration with Nobel Prize winner **Professor Hartmut Michel**, of Germany's Max Planck Institute of Biophysics, that has determined the atomic structure of a protein called bd oxidase. That discovery will serve as an important template for drug discovery and for producing fast acting drugs – ideally a four-week course, instead of the current side effect-heavy, six-month protocol, Professor Krause says.

"TB is the world's leading cause of death from infectious diseases and a rapid cure could lead to world-wide elimination of TB. This would have an enormous global health impact. The holy grail in infectious diseases would be a rapid cure for TB – and the determination of the bd oxidase structure from the bacterium that causes TB is a key first step in exactly that direction."

The bd oxidase protein lives in the cell membrane of the TB bacterium and helps it breathe under very low oxygen conditions that often occur in infected lungs during a TB infection. "Knowing the structure of this protein will speed up the process of designing and discovering small molecules that can block bd oxidase function and help to rapidly kill TB germs," Professor Krause says.

"Our detailed insights into the long-sought atomic framework of the cytochrome bd oxidase from Mycobacterium tuberculosis will form the basis for the design of highly specific drugs to act on this enzyme."

TB is one of the hardest infections to treat. It is very hardy, resilient, hard to kill and hard to study in the lab because it grows extremely slowly. Professor Cook says ten million people develop TB every year and it kills about 5000 people a day. It has infected two billion people and had killed one billion before anti-TB drugs were discovered.

"TB is hard to cure now because at best it requires normally four drugs taken for about six months and the side effects are extreme. In fact, people often cannot adhere to the regime because of the side effects and the length of the time the drugs must be taken. It requires more drugs over an even longer period if the TB bacteria causing the infection are resistant to common TB antibiotics, which happens on average in about 5 to 10 per cent of cases," Professor Cook says.

A Marsden Fund grant and Royal Society Te Apārangi Catalyst Funding have enabled Professors Krause and Cook to focus on this project for about six years, but scientists worldwide have been working on making this discovery for more than two decades.

"It is going to take a long time to reach this goal, but having the structure now in hand gives us exactly the encouragement we need to keep pushing forward toward our goal of rapid treatment for TB."

The research, published in the journal *Nature Communications*, is a true trans-disciplinary effort; Professor Cook's team focused on the microbiology of TB, testing possible inhibitors, designing genetic strains of Mycobacterium tuberculosis to work with and understanding the respiratory chain as a potential target for drug design. Professor Krause's team focused on the growth of bacteria to produce bd oxidase and the purification of bd oxidase, while Professor Michel and **Dr Schara Safarian** performed high resolution cryo electron microscopy measurements on the proteins supplied by Otago and determined the three-dimensional structure of bd oxidase.

Professor Krause says the plan now is to start building on the bd oxidase structure to understand its mechanism, identify tight inhibitors and refine these inhibitors into a multi-drug cocktail to rapidly cure TB.

To discover more visit Bit.ly/MF57-55

THE 'SUPERCOOLEST' SCIENCE ON EARTH

INGA SMITH, UNIVERSITY OF OTAGO

A team of Antarctic scientists is breaking new ground – or ice at least – in scientific research. They've designed a cutting-edge device to measure supercooled ocean water under sea ice.

Group photo with HiPSMI onboard Icefin. (L-R front): Maren Richter (UOO, PhD student), Dr Enrica Quartini (Cornell), Dr Inga Smith (UOO), Associate Professor Britney Schmidt (Cornell), Dan Dichek (Georgia Tech, kneeling), Professor Lars Smedsrud (Bergen), Brett Grant (NIWA), Dr Pete Russell (UOO). (L-R back): Dr Andy Mullen (Georgia Tech), Ben Hurwitz (Georgia Tech). Image: Dan Dichek

Near the sea ice camp in McMurdo Sound. (L-R) Drs Greg Leonard and Inga Smith (University of Otago), Associate Professor Britney Schmidt (Cornell University, USA), Professor Lars Smedsrud (University of Bergen, Norway)

The Kiwi-led project, funded by the Marsden Fund, is collaborating with Norwegian and US scientists to build a High Precision Supercooling Measurement Instrument (HiPSMI) that can be sent below the ice on the Icefin (a small, remotely-operated submersible robot) to precisely measure exactly how cold the water gets.

Dr Inga Smith, from the University of Otago, says sea ice usually freezes at -1.9 degrees Celsius. But that's not the case when fresh water flows from beneath an ice shelf and mixes with the salty sea water.

"Then it becomes what's called supercooled, so it's still liquid but actually below the freezing point. It then snap freezes into these crystals called frazil, they attach to the sea ice and form platelet ice. That means the sea ice in this area is thicker and grows faster than it would otherwise, certainly thicker and faster than you would expect in the Arctic, for example, in a similar location. We're really pushing the edge of polar engineering here, operating in these really cold temperatures and making high-precision measurements of that supercooling," she says.

Maren Richter, a PhD student from University of Otago, says oceans under ice shelves are a large black spot in our knowledge. "We know more about the dark side of the moon than we know about what's going on underneath the Ross Ice Shelf!

"These measurements help to inform understanding of how the system that is the ocean, the ice and the atmosphere works together, and how that all interconnects. These are all calculated by large scale models and the more accurate we can make these models, even on really small scales like this, the more accurate it will be on larger scales like informing weather in the future in New Zealand," she says.

To test the HiPSMI in Antarctica for the first time, the team worked out of a containerised ice camp on McMurdo Sound. **Sarah Williamson**, Antarctica New Zealand Chief Executive, says the containerised camp, owned by NIWA, was key for the team's success.

"They managed to collect oceanographic and sea ice data for 17 of the 20 days at the ice camp, and HiPSMI data on eight of those days. It's always satisfying when we can support this world-leading science so successfully in Antarctica, particularly when it has such important ramifications for the rest of the planet," she says.

To discover more visit Bit.ly/MF57-56

Platelet ice on a mooring rope
Image: Andy Mahoney

CREATING A MĀORI DISASTER MANAGEMENT FRAMEWORK

CHRISTINE KENNEY, MASSEY UNIVERSITY

Tangata whenua have extensive experience in successfully responding to catastrophic events in Aotearoa. Yet there is a lack of appreciation for, and understanding about how Māori attributes (knowledges, values and traditional practices) may enhance emergency responses to disasters.

Manaia taonga image supplied by Christine Kenney (above)

In this community-led Marsden Fund Fast Start project, **Associate Professor Christine Kenney** addresses this knowledge gap by exploring what, and how Māori attributes can be mobilised and/or combined in a Māori disaster management framework that is culturally acceptable and widely applicable. Designed by, for, and with Māori community partners in response to concerns raised by iwi and hapū, the research uses interviews, hui and wānanga to gather mātauranga Māori knowledge, develop ideas, and workshop the new framework to become a platform for advancing Māori disaster management aspirations.

Representatives from 15 iwi and 43 hapū have shared their views to date. Participants have reported that intergenerational emergency management education draws on visual communication tools within their wharenui meeting houses. The alignment of whakairo carvings, tukituki woven panel designs, and kōwhaiwhai painted patterns in wharenui present narratives of past events, contain risk communication messages and recommendations for Māori emergency management. Access to mātauranga is determined by kaupapa values or principles: whakapapa genealogy in particular –underpins and acts as a driver for emergency management, rangatiratanga leadership, kāwanatanga governance, and tikanga practices. Thus, cultural values act as moral imperatives in emergency management contexts as well as material and philosophical stimuli that influence how Māori respond to crises. Whakapapa also determines Māori emergency management roles, shapes responders' actions and their links with community, and potentially affects the distribution of resources to other Māori collectives. As mātauranga is region, hapū, and even whānau-specific, both strong and weak relational ties may be characterised as key influences on Māori emergency management approaches.

Participants at inaugural research hui, Te Kākano o te Aroha Marae, October 2018

Eight key kaupapa were initially identified as central to Māori emergency management: whakapapa genealogy; whakawhanaungatanga establishing relationships; manaakitanga hospitality, kindness; kotahitanga unity; rangatiratanga leadership; kaitiakitanga guardianship; wairuatanga spirituality; and mana motuhake separate identity.

Interviewees advocated for including taonga tuku iho – valuable tupuna ancestral knowledge and practices associated with kaitiakitanga. Ngā ipukarea has been added more recently, as ancestral homelands are sites that reinforce kinship ties and generate essential resources.

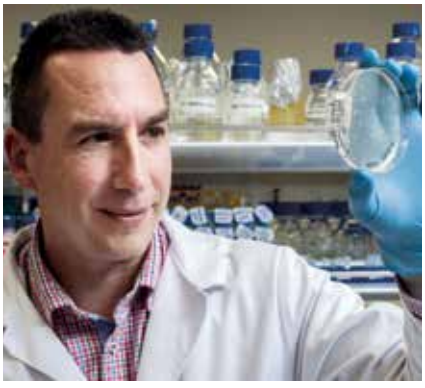
The draft Māori disaster management framework encompasses these ten kaupapa and has been provisionally entitled 'Te Taniwha'; a name that reflects how elements of the new model equate to qualities and actions associated with Taniwha – supernatural beings, who have been repeatedly referenced in participants' interviews as powerful change agents and shape changers, adaptable to evolving circumstances. Within te ao Māori, Taniwha are considered kaitiaki – associated with leadership, arbiters of right action and redressers of justice, as well as recipients and enactors of respect. Taniwha, and manaia in particular, are also considered spiritual beings – ethical messengers as well as risk communicators and managers for the atua. The research model is visually represented as a four fingered manaia, with the overall refinement – including the development of indicators and tikanga related to each kaupapa – currently underway.

To discover more visit Bit.ly/MF57-59

‘UNASSUMING’ ENZYME OPENS WAY FOR NEW MEDICAL TREATMENTS

DAVID ACKERLEY, TE HERENGA WAKA – VICTORIA UNIVERSITY OF WELLINGTON

Research could have important applications for treatment of cancer and other conditions



David Ackerley

It sounds like a plot for a Cold War thriller—training a gene to infiltrate a cell and reside there, unnoticed, until an external self-destruct signal induces it to destroy its new home. However, this is not a Le Carré spy novel, but a piece of cutting-edge biomedical science undertaken by researchers from Te Herenga Waka—Victoria University of Wellington, and their Johns Hopkins University collaborators in the United States, that could have important applications in the treatment of cancer and other conditions. Their paper was published this year in the journal *Nature Methods*.

David Ackerley, professor of biotechnology in the University’s Te Kura Mātauranga Koiora—School of Biological Sciences and leader of the New Zealand part of the study, says the agent in question is an “unassuming” bacterial enzyme called nitroreductase.

“While medical researchers usually want to focus more on ways to keep our cells alive, rather than killing them, being able to activate a genetic ‘kill switch’ that will target a precisely-defined set of cells actually has a wide range of uses. It can allow researchers to understand how certain cells function, by observing the effect of removing them from a model system, or screening for drugs that favour the regeneration and regrowth of those cells. A reliable ‘kill switch’ also enables doctors to trial otherwise risky new therapies, like engineering bone marrow or blood cells to protect vulnerable patients against a wide range of diseases.”

The need for this was illustrated by a gene therapy-trial in the early 2000s, which showed much promise for curing “bubble-baby disease”, where babies with immunodeficiency disorders must otherwise be raised in entirely sterile conditions, Professor Ackerley says.

“While some patients were completely cured by the gene therapy, unfortunately it caused leukaemia in others. Had the delivered genes

included a safe and reliable 'kill switch', doctors would have been able to immediately eliminate any cancerous cells that had arisen. However, ensuring both safety and reliability is a scientific challenge."

Co-leader of the study **Professor Jeff Mumm**, from the Wilmer Eye Institute at Johns Hopkins University, envisaged an elegant solution—a gene that encodes an enzyme able to activate an artificial drug from a non-toxic to a toxic form. "That way, the gene would be completely inert in any natural context, and a scientist or doctor could have total control over silencing cells containing that gene, by choosing when to administer the drug."

Professor Mumm's preferred drug was metronidazole—a common antibiotic known to be safe in patients, but able to be converted by certain enzymes to a toxic form that is 100 percent-contained by the activating cell, Professor Ackerley says.

"That property enables very clean elimination of target cells, without harm to neighbouring non-target cells. But Jeff's problem was that because metronidazole is a very artificial drug, nature has never evolved specific enzymes to be good at activating it. Our microbial biotechnology team has a lot of experience engineering enzymes to activate drugs like metronidazole and so we stepped in to help."

Lead researcher and Te Herenga Waka postdoctoral fellow **Dr Abby Sharrock**, and key team member and University research fellow **Dr Elsie Williams** studied a family of related enzymes that were promising but inefficient with metronidazole, and proposed two changes they might be able to make to substantially boost this activity.

Professor Ackerley says the result, made possible with Marsden Fund support, is an enzyme able to kill cells at 100-fold lower doses of metronidazole, "opening the way to many different research and medical applications not previously possible".

"Although our paper has only just been published, dozens of research teams from around the world have already requested the gene encoding the team's engineered enzyme. We are optimistic that our enhanced enzyme will spur breakthroughs in treatment of a wide-range of disorders, including various cancers and degenerative conditions."

To discover more visit Bit.ly/MF57-61

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SHINING A LIGHT – THE SHOCKING STATE OF NZ'S ACUTE MENTAL HEALTH UNITS

GABRIELLE JENKIN, UNIVERSITY OF OTAGO

In Pipiri June, current affairs website Newsroom published a series of research-based media reports by journalist Oliver Lewis on Aotearoa New Zealand's mental health units.

The series highlighted the findings of a major research project led by Director of the Suicide and Mental Health Research Group, **Dr Gabrielle Jenkin**, into the architectural design and social environment of New Zealand's acute mental health facilities.

Dr Jenkin's ground-breaking four-year research project, funded by a Marsden Fund Fast-Start grant, detailed the shocking state of the country's inpatient adult mental health units, finding staff often reduced to delivering a 'meds and beds' service in rundown, dilapidated buildings.

The major themes of the series were discussed on Radio New Zealand's (RNZ) *The Detail* podcast *Housing the mentally ill when the roof is caving in.*

Dr Jenkin was also interviewed on RNZ's *Nine To Noon* about her research.

To discover more visit Bit.ly/MF57-62

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NEWS FROM THE MARSDEN FUND


HE PITO
MATA

HE PITO MATA: EARLY CAREER RESEARCH WĀNANGA

AWAKENING THE POTENTIAL

In Pipiri June, the Marsden Fund supported representative body Early Career Researcher Forum Aotearoa to host a wānanga with other early career researchers (ECRs). ECRs include those studying a Masters or PhD and up to 10 years post-graduate qualification.

Over two days, 300 delegates convened at the Wharewaka in Wellington to connect, share and amplify the kōrero of ECRs in Aotearoa. **Professor Wendy Larner FRSNZ, Dr Rangi Matamua FRSNZ** and **Dr Sereana Naepi** acted as kaiwhakataki MCs.

A bold programme of keynotes, Q&A panels and networking was made possible thanks to the participation of many special guests, including **Professor Dame Jane Harding DNZM FRSNZ**, **Dr Ashley Bloomfield**, **Arapata Hakiwai** and **Courtney Johnson**, **Professor Shaun Hendy FRSNZ**, and **Associate Professor Selina Tusitala Marsh ONZM FRSNZ**. There were also opportunities for new connections with guests from broadcast, print and web media and governmental science advisers.

For outgoing Royal Society Te Apārangi President, Wendy Larner, supporting ECRs was a key issue for her term. As MC and patron of the wānanga, she said, "The Early Career Researcher workforce is our future, but this diverse group faces ever-present challenges to employment stability and these challenges are being exacerbated and amplified by the pandemic. If we don't get things right for them, our research landscape won't be the research landscape we need in the future."

ECRs discussed and drew attention to conditions that allow ECRs to thrive and possible ways to rethink the current RSI environment to address their hopes and concerns. In particular, they envision a sector founded on strong relationships, that provides more stable employment and seeks to deal with inequities within itself.

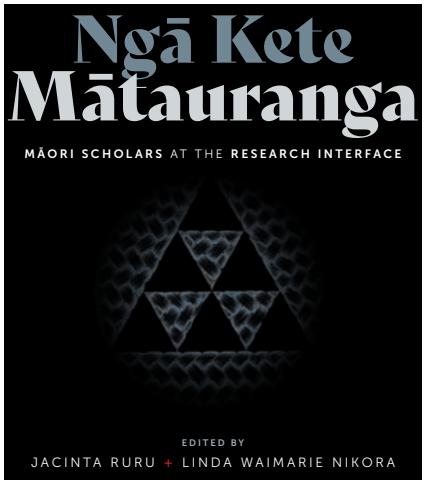
The name and kaupapa of the wānanga 'He Pito Mata' is taken from the whakatauki 'Iti noa, he pito mata', which refers to a small uncooked portion of kūmara that was replanted to produce many more kumara. Here it relates to awakening the potential of early career researchers in Aotearoa.

To discover more visit Bit.ly/MF57-65

NGĀ KETE MĀTAURANGA

TRANSFORMATIVE PERSONAL STORIES OF MĀORI SCHOLARS

A new book *Ngā Kete Mātauranga: Māori Scholars at the Research Interface* celebrates the collective aspirations of a generation of scholars for the advancement of Māori scholarship and the full expression of Māori academic excellence.



Professor Linda Waimarie Nikora (above) and Professor Jacinta Ruru (top right). Marsden-funded scholars, (L-R) Professor Joanna Kidman, Associate Professor Alice Te Punga Somerville, Dr Marama Muru-Lanning, Associate Professor Krushil Watene, Dr Dan Hikuroa, Dr Rangi Matamua, Dr Anne-Marie Jackson

The book is co-edited by **Professor Jacinta Ruru FRSNZ** and **Professor Linda Waimarie Nikora FRSNZ**, co-directors of Ngā Pae o te Māramatanga, and was published by Otago University Press in Poutūterangi March. In this transformative book, 24 Māori academics share their personal journeys, revealing what being Māori has meant for them in their work. Their perspectives provide insight for all New Zealanders into how mātauranga is positively influencing Western-dominated disciplines of knowledge in the research sector.

Professor Dame Juliet Gerrard DNZM FRSNZ, Prime Minister's Chief Science Adviser, said: "These deeply personal stories provide a portal into te ao Māori world, which many outside it seek to understand, but struggle to find a frame to do so."

Publication of the book was supported by Marden Fund and Royal Society Te Apārangi, in a continuation of work to strengthen relationships between Māori and non-Māori research communities. It follows on from support of *Te Takarangi*, a celebration of 150 Māori non-fiction books, profiled in 2018 to mark the 50th anniversary of Ngā Pae o te Māramatanga and the 150th anniversary of Royal Society Te Apārangi.

To discover more visit Bit.ly/MF57-66

Tuhia ki te rangi
Tuhia ke te whenua
Tuhia ki te ngākau a ngā tāngata
Tihei mauri ora!

Write it in the sky
Write it in the land
Write it in the heart of the people
Behold there is life!

IMPACT OF COVID-19 ON THE 2021 FUNDING ROUND

Disruption caused by the pandemic continued in 2021, so we are thankful that we were able to run the 2021 funding round. Some modifications were required, though fewer than in 2020.

February 2021 saw changes in the countrywide Alert levels, with Auckland moving up to Level 3, and the rest of Aotearoa New Zealand moving up to Level 2. With Auckland-based researchers differentially affected by this change, their applications could have been disadvantaged during this period of disruption. As a result, the Expression of Interest (EOI) deadline was extended by a week, from 18th February to 25th February.

The 2021 round saw a return to our usual EOI panel meetings in April. Due to the restrictions on international travel, all our Australian-based panellists were required to participate online. The meetings took place through a mix of online and face-to-face meetings, with one panel meeting entirely run online. The return of the EOI meetings meant that the trial to offer feedback to Fast-Start applicants placed in the 3rd quintile in the Engineering and Interdisciplinary Sciences (EIS) panel was able to proceed. This was scheduled for 2020 but was delayed.

The funding round then ran as planned, before Covid-19 disruptions occurred again in August 2021. With Aotearoa New Zealand moving to Alert Level 4 for an unknown length of time because of the Delta outbreak in mid-August, and Auckland bearing the brunt of the outbreak, we anticipated disruptions to researchers and research offices, especially in Auckland. As a result, we extended the main applicant response deadline for referee reports by 6 days, to 7th September (from 1st September). This was the latest we could extend the deadline whilst still allowing panel members enough time to read the applicant responses before the September panel meetings.

Full proposal meetings took place in September as scheduled, although due to the unpredictability of the Alert Levels, all the panel meetings were run online.

Impacts of Covid-19 on researchers

Existing Marsden Fund contract holders continued to experience significant disruption to their research due to the pandemic. As in 2020, these disruptions have prevented international travel, hampered recruitment of postgraduate students and staff, caused significant delays in shipments of research consumables and complicated international collaboration. As an indicator of the tremendous scale of this disruption to our researchers, we have observed a 2-5 fold-per-month increase in requests for Marsden Fund contract variations since June 2020.

Digital support for applicants in 2021

As in the 2020 round, the Research Funding team recorded a virtual roadshow on 'how to apply to the Marsden Fund in 2022'. We also ran a number of live sessions online to respond to questions from the research community. This approach provided a safeguard against potential domestic travel restrictions which could have prevented delivery of our usual roadshow. The digital channel also gave us wider reach to interested parties.


Spark
Spark

NO TE HURIHURINGA ON REFLECTION

PROFESSOR DAVID BILKEY

CHAIR, MARSDEN FUND COUNCIL

Kia ora koutou

Gravitation waves. A flexing of the spacetime fabric. Something akin to what might happen if a stone were thrown into a three-dimensional pond (or maybe that should be four-dimensional!). Hard to get your head around, but an investigation into these waves will help unravel this phenomenon and is one of the exciting projects that was supported by the Marsden Fund this last year. It is a great example of the way that the Fund can help stretch Aotearoa New Zealand's research sector. Not only will this project provide insights into a phenomenon that is fundamental to our understanding of the universe, but it will also generate valuable spinoffs in extending New Zealand's expertise in statistics, applied mathematics, astronomy and physics, while at the same time linking this expertise across multiple Universities and international collaborators.

While considering gravitational waves forces us to think about events at a Universe-level spatial scale, Marsden Funding has also been targeted at universal, but Earth-bound – questions that range from exploring resilience in the face of adversity, to investigating sustainability as it relates to death and bereavement. This latter project is a good example of how the Fund is continually improving its approaches to both the mātauranga Māori and Western research knowledge spheres, and where it occurs, the opportunity to interweave the two. Exciting Marsden-funded research is also being conducted in many other areas, with topics that range from fighting tuberculosis to highlighting the dire situation in our country's mental health units.

This breadth of topic area is one of the strengths of the Marsden Fund, as it underlies an innovative and flexible research sector. Each year we get over one thousand applications for support from across a diverse range of research disciplines and it is always exciting and interesting to see the wealth of ideas that are being generated by our discovery research sector. The top twenty percent of these applications are then peer reviewed by both international experts and our national expert panels and from there around half of the most highly rated applications receive support.

Unfortunately, this means that many excellent projects are declined funding, even though a large proportion of these applications have been judged worthy of funding by experts. This suggests that there is considerable opportunity being lost and begs the question as to whether support for discovery research is set appropriately in Aotearoa New Zealand.

Professor David Bilkey

At the present time the Marsden Fund, which is the primary supporter of investigator-led discovery research in this country, receives less than five percent of the funding directed via Vote Business, Science and Innovation to the overall research sector. Most of the remaining ninety-five percent is directed to mission-led, applied research. In contrast, data from several other advanced economies indicates that up to thirty percent of government research science and innovation investment is targeted to discovery research. That this difference exists suggests that the relationship between discovery and mission-led research in Aotearoa New Zealand may have become unbalanced to the detriment of fundamental discovery research.

A change in the balance of funding to discovery research would allow for an increase in the success rate of the Marsden Fund. This would allow for the support of more excellent proposals, thereby reducing the loss of unique and valuable knowledge, as well as growing a research capability and capacity that provides for resilience and underlies support for a stronger mission-led research sector.

Increased support would have the further benefit of increasing connectivity across the research sector as many Marsden-funded projects depend upon collaborations between researchers at different institutions. In fact, a high proportion of the projects we have funded involve a collaboration between researchers from at least two different research institutions and over half involve a collaboration with a researcher from outside Aotearoa New Zealand. These collaborations tend to increase and develop as a project matures and oftentimes they also involve the wider community as we see in several of the projects highlighted in this update. Therefore, the increased connectivity that would result from higher Marsden Fund success rates would benefit the whole sector by encouraging the flow of people, knowledge and capabilities, within and across both our research teams and the community more broadly.

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MARSDEN FUND RECIPIENTS

Project ID	Panel	Institution	Project	Principal Investigator	Funding (ex GST)
21-AUT-012	SOC	Auckland University of Technology Unitec Institute of Technology	Artefacts of relations: Building in the Pacific	Associate Professor AL Refiti Mr RV Hoskins	$838,000
21-AUT-024	SOC	Auckland University of Technology	Māori Flexible Learning Spaces (FLS) for supporting Mātauranga Māori and biculturalism in schools	Associate Professor GM Stewart	$838,000
21-AUT-037	SOC	Auckland University of Technology	He huarahi mo te wāhine Maori: Career sense-making among Māori women	Dr NA Staniland	$360,000
21-GNS-005	ESA	GNS Science	Lifting the veil on precursors to unheralded phreatic eruptions	Dr SCP Pearson-Grant	$360,000
21-LCR-001	EEB	Manaaki Whenua Landcare Research	Identifying the genomic underpinnings of successful asexuality	Professor TR Buckley	$926,000
21-LIU-017	EEB	Lincoln University	Reframing the way we think about disease emergence in the face of global change	Dr LP Waller	$360,000
21-LIU-026	ESA	Lincoln University	Untangling the controls on nitrous oxide emissions from braided rivers	Dr NS Wells	$360,000
21-MAU-012	HUM	Massey University	Do endangered languages get simpler under threat? Young people's language use in urban and rural communities in Vanuatu	Dr EC Ridge	$360,000
21-MAU-018	HUM	Massey University	Development and optimisation of Te Vairanga Tuatua, a multimedia-multipurpose corpus of Cook Islands Māori	Dr SAT Nicholas	$360,000
21-MAU-043	EHB	Massey University	Caught in a web of lies? Persistence and change in conspiracy theory beliefs	Dr MN Williams	$360,000
21-MAU-044	EEB	Massey University	Identifying the mechanisms that drive cultural evolution of song in natural songbird populations	Professor DH Brunton	$926,000
21-MAU-051	EHB	Massey University	Greening economics as an engine for sustainable solutions to climate change	Dr S Pieralli	$360,000
21-MAU-052	HUM	Massey University	Seen and heard: Understanding the media girls consume, create, and share in Aotearoa New Zealand	Dr KJ Clarke	$360,000
21-MAU-077	CMP	Massey University	A sticky question: Does intranuclear aggregation of HDAC4 promote neuronal dysfunction?	Dr HL Fitzsimons	$939,000
21-MAU-078	SOC	Massey University Victoria University of Wellington	Samting i narakain: Understanding change in the Pacific from the inside	Professor GA Banks Professor JD Overton	$838,000
21-MAU-102	SOC	Massey University	Reimagining South Pacific tourism: Harnessing resilience and sustainability in a world of increasing disorder	Dr ARN Movono	$360,000
21-MAU-108	MIS	Massey University	Modern analysis and geometry	Distinguished Professor GJ Martin	$685,000
21-MAU-148	SOC	Massey University Massey University	Apprehending ableism: A transformative analysis of able-bodied privilege in Aotearoa New Zealand	Dr PA Carroll Professor KL Witten	$838,000
21-MIM-003	BMS	Malaghan Institute of Medical Research	Does fever impact T cell metabolism and function during infectious disease?	Dr D O'Sullivan	$360,000
21-NIW-014	ESA	National Institute of Water and Atmospheric Research Ltd National Institute of Water and Atmospheric Research Ltd	Tracking the lateral transfer of organic carbon by submarine canyon systems: A missing sink in global carbon budgets?	Dr KL Maier Dr SD Nodder	$913,000
21-NIW-024	ESA	National Institute of Water and Atmospheric Research Ltd	Crossing the dimensional divide: Non-linear interaction between submesoscale eddies and turbulence	Associate Professor CL Stevens	$913,000

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21-PVT-002	HUM	Speedy Research & Consulting	When colonial worlds connect: trans-imperial networks of forced labour between the Indian and Pacific Oceans and the untold stories of Reunionese Creoles in Oceania	Associate Professor KE Speedy	$455,000
21-PVT-005	SOC	University of Auckland	Placing unheard voices: The lived experience and geography of young-onset Parkinson's disease	Dr TM Coleman	$360,000
21-UOA-008	ESA	University of Auckland	Black hole ecology: Understanding the masses of black holes formed in stellar deaths	Associate Professor JJ Eldridge	$913,000
21-UOA-009	EIS	University of Auckland	Force and light to understand the structure: Function relationship of soft tissue at the microscale	Associate Professor FDG Vanholsbeeck	$916,000
21-UOA-036	MIS	University of Auckland	Relentlessly complex? New algorithmic foundations to analyze complex evolution	Dr S Linz	$637,000
21-UOA-041	EIS	University of Auckland	Investigating the underlying causes of imbalance in micro-scale current distribution and bubble behaviour on electrode/catalyst surfaces in water electrolysis	Dr JJ Liu	$360,000
21-UOA-048	MIS	University of Auckland	Beyond survival of the fittest: Population dynamics of cyclic competition networks	Associate Professor CM Postlethwaite	$684,000
21-UOA-058	MIS	University of Auckland	Rejuvenating the role of random fields in modelling spatiotemporal point patterns: A new era of point process models	Dr CM Jones-Todd	$360,000
21-UOA-059	EIS	University of Auckland	Making a splash: Accounting for air in water impacts	Dr TD Allen	$360,000
21-UOA-060	HUM	University of Auckland	Taboo: A literary and cultural history	Associate Professor AJ Calder	$494,000
21-UOA-069	PCB	University of Auckland	Superatoms: Catalysts for CO2 activation	Dr C Sikorska	$360,000
21-UOA-070	SOC	University of Auckland Te Wānanga o Raukawa Unitec Institute of Technology	Matike Mai Te Hiaroa: #ProtectIhumātao	Dr FP Hancock Associate Professor CH Jones Professor JB-J Lee-Morgan	$838,000
21-UOA-081	EHB	University of Auckland	Eye movements in three dimensions	Dr PRK Turnbull	$360,000
21-UOA-105	MFC	University of Auckland	Gravitational waves: Sources and signals	Professor R Meyer	$3,000,000
21-UOA-108	CMP	University of Auckland	How does allostery modulate bacterial pathogenesis?	Dr G Bashiri	$939,000
21-UOA-120	SOC	University of Auckland	Performing mathematics learner identities in online contexts	Dr LJ Darragh	$360,000
21-UOA-130	EHB	University of Auckland	The neural dynamics of cognitive control: Theta-range neural oscillations and frontal executive function	Professor IJ Kirk	$825,000
21-UOA-134	EHB	University of Auckland	Anauralia: The enigma of the silent mind	Professor AJ Lambert	$833,000
21-UOA-173	HUM	University of Auckland	Strengthening democracy for the Twenty-First Century	Associate Professor TK Kuhner	$660,000
21-UOA-174	MIS	University of Auckland	A geometric study of exceptional symmetry	Dr JJ Schillewaert	$554,000
21-UOA-178	CMP	University of Auckland	Where lies the treasure? Using random DNA to find the functional regions of genomes	Dr ARD Ganley	$939,000
21-UOA-179	PCB	University of Auckland Victoria University of Wellington	Designing nanopatterns: Exploring the "dark world" of binary liquid metals	Associate Professor N Gaston Dr KG Steenbergen	$922,000
21-UOA-180	EIS	University of Auckland	Electroceuticals in the gut: Multimodal imaging and modelling to unlock peristalsis	Dr N Paskaranandavadivel	$916,000
21-UOA-190	BMS	University of Auckland	Why are two Xs better than one? Modifying X inactivation for the treatment of X-linked neurological disorders	Dr EL Scotter	$960,000
21-UOA-207	EIS	University of Auckland RMIT University	Keeping spatters at bay and in situ synthesis	Associate Professor P Cao Distinguished Professor M Qian	$916,000

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21-UOA-215	EIS	University of Auckland	Ultra-broadband microresonator dual-combs in photonic belt resonators	Dr VWC Ng	$360,000
21-UOA-219	MIS	University of Auckland	Unsupervised spatio-temporal representation learning for dynamic graphs	Dr K Zhao	$360,000
21-UOA-237	PCB	University of Auckland	Understanding selectivity determinants in CO2 electrochemical reduction reaction	Dr Z Wang	$360,000
21-UOA-248	BMS	University of Auckland	Preeclampsia: Mother vs placenta	Dr CJ Barrett	$960,000
21-UOA-262	CMP	University of Auckland	Experimentally probing the RNA to DNA transition at the origin of modern genomes	Professor AM Poole	$939,000
21-UOA-272	SOC	University of Auckland	Imagineering national futures: Global management consultancies and extrastate knowledge infrastructure in Aotearoa	Associate Professor NI Lewis	$815,000
21-UOA-280	PCB	University of Auckland University of Auckland	Photons on demand: Dial-up your number	Dr MD Hoogerland Associate Professor AS Parkins	$921,000
21-UOA-300	EHB	University of Auckland	Learning to see the world: Visual understanding through unsupervised learning	Dr KR Storrs	$360,000
21-UOC-013	PCB	University of Canterbury	Radically different: New reactions of unprotected sugars in aqueous solution	Professor AJ Fairbanks	$921,000
21-UOC-017	EIS	University of Canterbury	Accelerating the advent of physics-based ground-motion simulation for seismic hazard analysis	Professor BA Bradley	$916,000
21-UOC-038	EIS	University of Canterbury	Creating a physics-based understanding of the spatial correlation of earthquake-induced ground motions in regions of complex geology	Dr RL Lee	$360,000
21-UOC-040	EEB	University of Canterbury	Avian diversity in the aftermath of the Cretaceous-Paleogene (K/Pg) mass extinction: Zealandia as a hub for the evolution of marine birds	Dr VL De Pietri	$925,000
21-UOC-046	EHB	University of Canterbury	Multi-sensory speech perception and syllable structure	Dr DJ Derrick	$839,000
21-UOC-059	EEB	University of Canterbury	Understanding when and why predictions succeed or fail for species distributions	Dr HR Lai	$360,000
21-UOC-060	HUM	University of Canterbury	Understanding the nature of word grammar through Te Reo Māori	Dr FA Panther	$360,000
21-UOC-084	EEB	University of Canterbury	Eight legs and a mind for numbers	Dr FR Cross	$926,000
21-UOC-092	SOC	University of Canterbury	The greening of death in Aotearoa: Co-designing sustainability adaptations in body disposal	Associate Professor R McManus	$824,000
21-UOC-107	HUM	University of Canterbury	Do patterns of covariation in speech carry social meaning?	Associate Professor KD Watson	$659,000
21-UOC-108	EHB	University of Canterbury University of Oxford	Bifurcating neurons and the thalamic control of memory	Professor JC Dalrymple-Alford Associate Professor AS Mitchell	$839,000
21-UOC-115	EIS	University of Canterbury University of Canterbury	Thinking outside the square! Discovering the design rules for a new class of highly-functional nanomaterials	Professor MW Allen Professor RJ Reeves	$904,000
21-UOO-002	EEB	University of Otago	Parasite microbiomes and host manipulation: Who's really pulling the strings?	Professor R Poulin	$926,000
21-UOO-023	CMP	University of Otago	Investigating the roots of resilience to climate change in kuku at single cell resolution	Dr NJ Kenny	$360,000
21-UOO-026	HUM	University of Otago Massey University	Kaitiakitanga and Antarctic narratives	Associate Professor P Wehi Associate Professor KPM Watene	$660,000
21-UOO-030	EHB	University of Otago	Embodied colonialism: Biohistories of 19th-century pakeha and Chinese migrants to New Zealand	Dr AME Sohler	$360,000

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21-UOO-039	EEB	University of Otago University of Waikato	The olfactory cocktail party: How animals and humans segregate mixed odours	Dr P Szyszka Dr TL Edwards	$926,000
21-UOO-040	BMS	University of Otago	Rewarding mum: Hormones supporting maternal-infant interactions	Dr RSE Brown	$960,000
21-UOO-057	MIS	University of Canterbury University of Auckland	Training natural language models to understand genomics and study gout in Māori and Pacific populations	Dr AN Gavryushkin Professor MJ Witbrock	$685,000
21-UOO-076	BMS	University of Otago	Reprogramming transcription with a flexible degradation machine	Associate Professor PD Mace	$960,000
21-UOO-086	EEB	University of Otago	Succession or suppression: How do sex-changing fish know when they should or shouldn't change sex?	Distinguished Professor NJ Gemmell	$926,000
21-UOO-087	EEB	University of Otago	Molecular time-capsules of oceans past: Reconstructing Antarctica's marine ecosystems using historical environmental DNA from marine invertebrate collections	Dr GJ Jeunen	$360,000
21-UOO-088	BMS	University of Otago	Recovery of red blood cells from oxidative stress: A window on human ageing	Professor MB Hampton	$960,000
21-UOO-123	ESA	University of Otago	Laboratory exploration of co-crystal minerals for planetary chemistry: Assisting NASA Dragonfly's search for the origins-of-life on Titan.	Dr CP Ennis	$875,000
21-UOO-128	BMS	University of Otago	A novel amyloid formation mechanism ignited by oxidation	Dr C Goebl	$960,000
21-UOO-140	BMS	University of Otago	Taking the driver's seat: Suppressing tumour metastasis by eliminating epigenetic drivers	Dr EJ Rodger	$960,000
21-UOO-154	MIS	University of Otago	Egocentric vision augmentation: Coherent visual integration for AR through real-time view modelling	Associate Professor TM Langlotz	$665,000
21-UOO-164	BMS	University of Otago University of Otago	The missing link: LncRNA regulation of lysosome function in brain disease	Associate Professor SM Hughes Dr I Basak	$960,000
21-UOO-182	CMP	University of Otago	Neurons to keep mums cool	Dr SR Ladyman	$939,000
21-UOO-186	EHB	University of Otago	How do sensory shifts shape our diet? Testing the neural mechanisms underpinning nutrient selection	Dr M Peng	$839,000
21-UOO-192	BMS	University of Otago	How does stress cause anxiety?	Dr JS Kim	$360,000
21-UOO-212	EEB	University of Otago	Beyond sperm transport: How seminal fluid shapes the female life course	Dr M Garratt	$926,000
21-UOO-217	HUM	University of Otago	Paraconsistent computablility theory	Associate Professor ZJ Weber	$660,000
21-UOO-238	CMP	University of Otago	Deciphering translation of the 'untranslated' regions of messenger RNAs	Dr CS Lim	$360,000
21-UOO-250	CMP	University of Otago	Making heads or tails of bees: Understanding the evolution of the first stages of embryogenesis	Dr A Oliphant	$360,000
21-UOO-251	BMS	University of Otago	Targeting CaMKII to tune cardiac structure and restore function in the diabetic heart	Dr JR Erickson	$959,000
21-UOW-007	EIS	University of Waikato	Advancing understanding of atomic-scale interface formation and heat transfer in composite materials	Dr F Yang	$916,000
21-UOW-008	EHB	University of Waikato	Accurately dating the Māori past using marine shell	Associate Professor FJ Petchey	$839,000
21-UOW-034	SOC	University of Waikato University of Auckland	Beyond the cycle of shame and silence: A relational study of intersex experience	Professor K Roen Professor LE Allen	$838,000
21-UOW-052	SOC	University of Waikato	Answering the Christchurch Call: Investigating New Zealand-based white supremacist discourse on social media	Dr JB Phillips	$360,000

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21-UOW-078	EIS	University of Waikato	Thermoelastic stress tomography: Using heat to detect, map and quantifying the effect of hidden defects	Dr RC Tighe	$360,000
21-UOW-081	SOC	University of Waikato University of Canterbury	Ngā hanganga mātua o te whakaako hitori: Critical pedagogies for history educators in Aotearoa New Zealand	Dr N Mahuika Dr RF Manning	$817,000
21-UOW-106	EIS	University of Waikato	Soil organics matter: Exploring abiotic pathways to mitigation of agricultural nitrous oxide emissions	Dr D Torres-Rojas	$360,000
21-VUW-011	CMP	Victoria University of Wellington	A new role for the amniotic cavity	Associate Professor PL Pfeffer	$939,000
21-VUW-012	ESA	Victoria University of Wellington	How did changing sea ice conditions impact primary production in the Ross Sea over the past 200 years?	Dr VHL Winton	$360,000
21-VUW-021	EEB	Victoria University of Wellington	The geometry of coexistence: Bio-optical niche modelling of coral-symbiotic microalgae under climate change	Dr MR Nitschke	$360,000
21-VUW-032	CMP	Victoria University of Wellington	Uncovering the novel biochemistries of the seaweed microbiome: The metabolic heavy lifters of the ocean	Dr CJ Vickers	$360,000
21-VUW-041	EIS	Victoria University of Wellington	Magnetism without angular momentum: High speed low power cryogenic memory	Dr SE Granville	$916,000
21-VUW-103	ESA	Victoria University of Wellington	Can snow change the fate of Antarctic sea ice?	Dr R Dadic	$913,000
21-VUW-108	SOC	Victoria University of Wellington	An ethnographic study of 1080 pest control and the Anthropocene in Aotearoa	Dr CP Addison	$360,000
21-VUW-109	SOC	Victoria University of Wellington	The social lives of sex hormones: (Re)imagining our bodies, ourselves in Aotearoa New Zealand	Dr NS Appleton	$360,000
21-VUW-111	EHB	Victoria University of Wellington	Structure of human music perception	Dr SA Mehr	$839,000
21-VUW-112	EHB	Victoria University of Wellington	Understanding the drivers of adolescent depression: The role of personal memories	Professor KE Salmon	$839,000
21-VUW-116	ESA	Victoria University of Wellington	The Silent Trigger: Do slow-slip earthquakes trigger volcanic unrest in the Taupō Volcanic Zone?	Dr F Illsley-Kemp	$360,000
21-VUW-120	PCB	Victoria University of Wellington	Molecular indium phosphide: A bottom-up approach to the synthesis of InP materials	Dr MD Anker	$360,000
21-VUW-122	PCB	Victoria University of Wellington	How the nose knows? Understanding the mechanisms in insect olfactory biosensor devices	Dr NOV Plank	$922,000
21-VUW-123	PCB	Victoria University of Wellington	Electromagnetic scattering by particles of arbitrary size and shape with application to microplastics	Professor EC Le Ru	$921,000
21-VUW-129	ESA	Victoria University of Wellington	Turbulence in the Intracluster Medium: toward the robust extraction of physical parameters	Dr YC Perrott	$360,000
21-VUW-145	MIS	Victoria University of Wellington Uppsala University	Gradual concurrency: Correctness, simplicity, and performance via dynamic ownership	Professor RJ Noble Professor ST Wrigstad	$685,000
21-VUW-156	MIS	Victoria University of Wellington Victoria University of Wellington	Establishing a structure theory for C*-algebras of non-Hausdorff groupoids	Associate Professor LO Clark Professor A an Huef	$685,000
21-VUW-205	SOC	Victoria University of Wellington	How does global order change? Precedent, domestic politics and the evolution of international trade rules from 1950 to 2020	Dr MA Castle	$360,000
21-VUW-208	MIS	Victoria University of Wellington	A novel genetic programming approach to image classification	Dr Y Bi	$360,000

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21-VUW-221	SOC	Victoria University of Wellington	Towards socioculturally responsible and inclusive stewardship of Digital Indigenous knowledge Collections (D-IKC)	Associate Professor CL Liew	$836,000
21-VUW-232	HUM	Victoria University of Wellington Victoria University of Wellington	Reimagining ocean law to achieve equitable and sustainable use of marine ecosystems	Associate Professor JC Mossop Dr RM Moynihan Magsig	$660,000
21-VUW-233	ESA	Victoria University of Wellington	Climatic and environmental impacts of the largest explosive volcanic eruptions on Earth	Dr SJ Barker	$913,000

This list of recipients is abridged.

For the complete list of awarded Marsden Fund investigators, including abstracts of all projects, visit: Bit.ly/MF57-73

Whakapā mai | Contact us

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