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FACULTY OF SCIENCE NEWSLETTER

FACULTY OF SCIENCE
THE UNIVERSITY OF HONG KONG
香港大學理學院

Message from the Chief Editor

In this issue of Faculty Newsletter, the Spotlights Column will bring you excitement by taking a sneak peek at the pioneering work from some of our young faculties. These investigators will share with us their significant research accomplishments and subsequent societal impacts upon successful downstream translation of their newly developed technologies. In addition to giving us a taste of their research directions, these up-and-coming scientists will reflect on the important scientific questions to be addressed and where they see themselves in five to ten years.

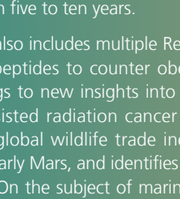
The Newsletter also includes multiple Research Stories ranging from designer peptides to counter obesity and ant-inspired allergy-safe drugs to new insights into magnetism at the 1D level and AI-assisted radiation cancer therapy. Our Faculty also addresses global wildlife trade inequality, explores the atmosphere of early Mars, and identifies oyster reefs as coaster water purifiers. On the subject of marine ecology, one of our PhD students steps up to establish a company to bridge the gap between designing 3D-printed biocompatible tiles and real-life coral reef restoration.

Innovation and research have always been closely related. Two research laboratories led by two top-notch researchers from the Department of Chemistry have been admitted to the InnoHK programme launched by Innovation and Technology Commission, HKSAR, aiming to conduct collaborative research projects that will change our lives. Interviews of these two Principal Investigators are included in this issue to give an overview of their mission and vision.

Beyond advances in research, our Faculty recently launched a new Double Degree in Science and Laws to nurture next-generation legal professionals equipped with a sound scientific background as Hong Kong aims to become a STEM-driven society and an innovation hub. With new inventions, patents need to be filed in a timely fashion, while policies need to be updated for regulation purposes. This fresh fleet of academic talents with legal mindsets and scientific knowledge will generate impact locally, regionally, nationally, and globally by setting standards and precedence on dealing with future intellectual property and technology matters.

This Faculty Newsletter issue is stimulating in a sense that it is more than a report of what major progress has occurred in the past six months. Sit tight, keep reading, and get ready for what lies ahead!

Yours sincerely,



Dr Edmund Chun Ming TSE
Chief Editor
Assistant Professor, Department of Chemistry

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Meet our young scientists who shape the future of our lives

View the full versions of the self-introduction of our young scientists
https://bit.ly/3qEZ4oK

Researchers are key for science and engines of scientific thoughts that form the basis for new research and innovation and shape the future of our lives.

In this issue, we will introduce some of our young scholars from diverse fields running impactful projects with great potential, developing collaborative projects with experts from all over the world, and being recognised by awards and honours in the research community.

You may get a glimpse of what the future will look like by reading through their self-introductions which reflect their visions beyond our imaginations.

'When I worked as an undergraduate in an ecology lab, I realised my calling and never looked back.'

Biological Sciences

Dr Timothy BONEBRAKE
Associate Dean of Science (Teaching & Learning) and Associate Professor of School of Biological Sciences

2020 NSFC Excellent Young Scientists Fund (Hong Kong & Macau)
Founding member of The Hong Kong Young Academy of Sciences
Chair of the Conservation Committee of WWF-HK

Though trained as a butterfly biologist, I have expanded my research programme to cover a wide range of plants, snakes, birds, and mammals.

The mission of my research group, the Global Change and Tropical Conservation Lab, is to conserve tropical biodiversity and bring together quantitative modelling tools and on-the-ground fieldwork. In the past couple of years, my group has done a lot of research on pangolins. All eight species globally are threatened by demand for their scales in Traditional Chinese Medicine (and other threats). So, my group is applying a wide range of conservation forensics tools (genomics, stable isotopes, etc.) to characterise trade dynamics and assist in making trade regulations. We also have close collaborative links with the School of Public Health to determine what links there are between trade and pathogen emergence.

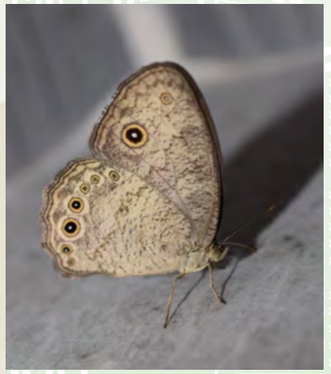


Photo credit: Dr Timothy Bonebrake

Most of the work I do is translational in some way. I got into science initially because I wanted to change policy and conserve biodiversity. Getting science into the hands of practitioners and policymakers takes a lot of work. My lab spends a lot of time meeting with government officials, NGOs, and corporations – we talk about the science we are currently doing and make recommendations for conserving biodiversity. Sometimes this comes to highlighting simple facts. For example, most people do not know that we have otters living in Hong Kong! Other times, this is more complex, examining laws or administrative procedures that may require change or updating. But the work is important, and publishing papers is certainly not itself sufficient to make an impact.

In five to ten years, I see myself continuing to run models for a better understanding of biodiversity responses to environmental change, and I will probably still be exploring wild places, overseas and in Hong Kong.

Visit the website of Global Change and Tropical Conservation Lab:
http://web.hku.hk/~tbone

View the full versions of the self-introduction of our young scientists
https://bit.ly/3qEZ4oK

Biological Sciences

Dr David BAKER
Associate Professor of School of Biological Sciences

2020 Collaborative Research Fund, Research Grants Council
Director of Stable Isotope Ratio Mass Spectrometry Laboratory, HKU
Associate Editor of *Limnology & Oceanography*

'Ultimately, we aim to provide insights as to the cost-benefit of environmental protection and ecosystem restoration; such information is essential knowledge for our local policymakers.'

I have worked on a variety of research topics, from the nature of marine symbioses to wildlife trade and environmental restoration. My team has shown that climate change can turn a coral's symbiont into a parasite. This knowledge tempers our hopes that corals can be 'engineered' to withstand climate change. A symbiotic partner could be a 'fair weather friend' – meaning they are only cooperative with their host when the environment is just right. There are many parallels to explore across the kingdoms of life, from forests to the human gut.

We conducted a preliminary survey of Hong Kong's marine areas with an emphasis on Tolo Harbour. Through that work, we discovered new species and new species records for Hong Kong, as well as detected an alarming array of human pathogens and health risk factors like antimicrobial resistance genes.

With exciting technologies developed at HKU, which led to the spin-off company 'archiREEF Ltd.', we are excited to discover how 3D printing eco-friendly structures can enhance both biodiversity and ecosystem functioning as we prepare Hong Kong and China for a warmer and wetter future.

One of the most important questions I want to address is: 'If you build it, will they come?' We want to know how structural complexity enhances marine biodiversity – the totality of living organisms in a habitat. We predict that there will be an optimal level of complexity that fosters the 'best' diversity under a given condition. Ultimately, we aim to provide insights as to the cost-benefit of environmental protection and ecosystem restoration; such information is essential knowledge for our local policymakers to make informed decisions about the future management of our natural resources, and so that our environment has a holistic accounting of its inherent value in terms of genetic wealth and ecosystem services.

Visit the website of Coral Biogeochemistry Laboratory:
http://www.thelifeisotopic.com

Biological Sciences

Dr Louise A ASHTON
Assistant Professor of School of Biological Sciences

2019-20 Faculty Research Output Prize, HKU
2021 NSFC Excellent Young Scientists Fund (Hong Kong & Macau)

'I want to increase our understanding of the importance of insect biodiversity and ecosystem function in tropical regions, and help inform policy and conservation to protect nature in the future.'

Photo credit: Dr Timothy Bonebrake

We exist in human-modified landscapes, so there are lots of interesting questions about how human impacts shape biodiversity. Most of my research has been on insects in tropical rainforests. I have worked on a range of insects groups, including termites, moths and ants, to understand the importance of insects in ecosystem function and how humans are altering biodiversity.

At the moment, I am working on understanding climate change impacts on insects across a range of ecosystems. We still have a poor understanding of how many species there are in tropical rainforests, let alone how this biodiversity is responding to multiple human impacts such as climate change, habitat loss and light pollution. My ongoing research projects seek to describe tropical insects, their functions and the threats to them. As we live in landscapes disturbed by humans, it is important to understand insect biodiversity across different ecosystem types. I am currently investigating insects across a range of disturbance levels from untouched primary forest to logged forest, oil palm and rice ecosystems.

I will continue to work on aspects of insect biodiversity and environmental change. Nature is the life support system that all humans rely on for our existence, but we are pushing nature beyond the boundaries of ecological function. I want to teach this at levels from primary school to university courses and communicate my work as widely as possible. I hope to train young scientists to have a passion for the natural world and a shared goal of understanding and conserving biodiversity and tropical ecosystems.

Visit the website of Biodiversity and Environmental Change Lab:
http://louiseashton.net

'In the longer-term, I hope to translate our research into actionable plans, and to help resolve some practical environmental and ecological problems in the real-world.'

Biological Sciences

Dr Jin WU
Assistant Professor of School of Biological Sciences

2019 NSFC Excellent Young Scientists Fund (Hong Kong & Macau)
2018 Best Young Investigator Paper Award of the Sino-Ecologists Associations
2017 Goldhaber Distinguished Fellowship from Brookhaven National Laboratory, US

My research covers a wide range of topics in global ecology and remote sensing, including developing novel space technology for plant ecology, exploring mechanisms of plant-climate interactions, improving math representations of these mechanisms in computer models, and leveraging cutting-edge sensor technologies and models to advance both real-time Earth's surface monitoring and longer-term projection of climate change impacts. Throughout this research, I hope to generate important outcomes that ultimately can lead to actionable plans to help sustain our natural ecosystems with global climate change.

My research group has been developing an integrated approach that combines cutting-edge space technology and AI technique with domain knowledge to improve characterisations of aspects of plant functional traits and understanding of fundamental eco-evolutionary mechanisms driving their variability over large geographical areas. By integrating these observed patterns and mechanisms of plant functional traits with state-of-the-art models, my lab research will improve assessments of climate change impacts on many important terrestrial processes, ranging from ecosystem structure to composition, functioning and services. These research outputs will ultimately bring new insights in science and technology and address climate change related environmental issues, such as forest health monitoring and management, precision agriculture and food security problems, as well as nature-based solutions to mitigate climate change impacts, including reaching the carbon neutrality goal.

In the longer term, I am thinking to collaborate with stakeholders and industry partners, by which we can immediately translate our research into something useful that can make direct impacts to end users and help resolve some real-world environmental and ecological problems.

Visit the website of Global Ecology and Remote Sensing Lab:
https://wu-jin.weebly.com

Biological Sciences

Dr Karen Wing Yee YUEN
Associate Professor of School of Biological Sciences

2016 Second Prize for the Best Research Output, Strategic Research Theme – Development and Reproduction, HKU
2012 Early Career Award, Research Grants Council

'I believe that basic, fundamental research in understanding how nature works should precede or be done in parallel with translational research.'

My most significant research accomplishments are contributing to the understanding of how centromere functions. The centromere is the unique region on each chromosome that binds to microtubules emanated from the opposite spindle poles to orchestrate chromosome movement and segregation in every cell division. My lab has provided insights into the epigenetic regulation of centromere function and elucidated the centromere formation process in vivo. Our results also have implications for cancer research, as chromosome instability (CIN) is one of the underlying hallmarks of many solid cancers. However, the molecular causes and consequences of it are still unclear.

Centromere inactivation or new centromere formation could initiate CIN. If we understand the mechanism of centromere formation, then we can engineer more stably propagating artificial chromosomes to carry any gene of interest for studying specific gene functions or for gene therapy. Therefore, the most important question I want to address is how the centromere maintains its stability through mitotic cell cycles and through multiple generations. This can be achieved by studying how different genetic and epigenetic pathways contribute to maintaining centromere identity. On the flip side, by understanding how centromeres are inactivated or how new centromeres are formed in pathological conditions, we can get a peek at how normal cells cope with the situation faithfully day after day.

I see myself continue to contribute and lead in the field of centromere regulation and chromosome stability. I believe that basic, fundamental research in understanding how nature works should precede or be done in parallel with translational research or biomedical engineering. Researchers can first humbly learn how existing organisms tackle the problem before engineering and improving our designs, as nature may already have the best solutions waiting for us to discover. Our lab projects will still focus on the conserved, important cellular mechanisms but will also expand to have synthetic biology and translational components.

Visit the website of Yuen Lab:
https://bit.ly/30Gupwh

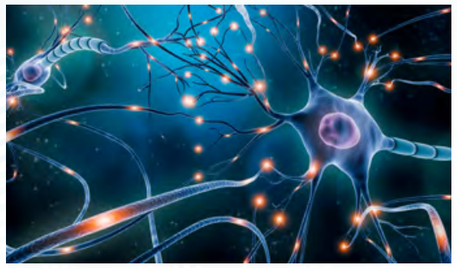
'Once we understand the organising principles for neuronal development at the system level, there may be a chance to tackle the daunting questions about the formation of the human brain.'

Biological Sciences

Dr Chaogu ZHENG
Assistant Professor of School of Biological Sciences

2021 NSFC Excellent Young Scientists Fund (Hong Kong & Macau)
2016 Peter Sajovic Memorial Prize, Columbia University
2015 Kavli Award for Distinguished Research in Neuroscience, Columbia University

I have been working on the genetic mechanisms that regulate the differentiation of neurons in the nervous system for the past 13 years. I think one of the most important questions in neuroscience and arguably in biology is how the nervous system is formed. The brain has over 80 billion neurons and 100 trillion synaptic connections. It is a super complex structure that is difficult to study. One possible way out from the challenge is to study something simple first. This is why my research team chose to work on this nematode, *Caenorhabditis elegans*, which has only 302 neurons. The research community has made a lot of progresses in understanding the development of the nervous system in this model organism. For example, we have the complete connectome, which provides an excellent platform to study the assembly of neural circuits. Once we understand the organising principles for neuronal development at the system level, there may be a chance to tackle the daunting questions about the formation of the human brain. I also think understanding the organisation of the brain can help other fields, such as computer science and artificial intelligence. My specific contribution to the field would be a series of studies that illustrates the genetic control of the differentiation of mechanosensory neurons (called Touch Receptor Neurons), from cell fate determination to subtype diversification to the growth of axons, at the single-cell resolution. We found that the organising principles for neuronal differentiation in this type of neurons appeared to be conserved in other neurons, including mammalian neurons. In the the next five to ten years, I hope to make some contributions in three areas, including 1) the mechanisms of neuronal differentiation and neural circuit assembly; 2) microbe-host interaction in neurodegeneration; 3) the genomic basis for the evolution of neuronal diversity.



Visit the website of Zheng Lab:
https://www.zhenglabhku.org

'As a space plasma physicist, a fascinating question I would like to address is whether we can use basic plasma theory to simulate the whole solar system.'

Earth Sciences

Dr Binzheng ZHANG
Assistant Professor of Department of Earth Sciences

2019 NSFC Excellent Young Scientists Fund (Hong Kong & Macau)
2014 NASA-Space Grant Award

My research focuses on studying the dynamics of planetary space environments, including terrestrial planets, gas giants and their moons as well as ice giants on my list for the future. I am a computational physicist or geophysicist working on large-scale system dynamics using the world's most powerful supercomputers. Basically, we 'create' a virtual space environment in powerful supercomputers for scientists and engineers to perform research and development. My most significant research accomplishment is the development of a high-performance computing-based, multi-physics, general-purposed code named 'GAMERA', for the research community to study planetary space environment research. GAMERA has been used by groups all over the world.

One of the most interesting research projects I am currently working is to simulate the space environment of the gas giant Jupiter, aka the Jovian magnetosphere. This is a very challenging task because the Jovian magnetosphere is gigantic – which would occupy approximately 1/3 of the whole sky if we could see the magnetic fields using our eyes. Thus, it requires a fine design of the numerical algorithms and computational grids to be able to resolve the structures that are important for understanding. On the other hand, this kind of system is multi-scale and requires a fusion of both physics theories and applied math, together with advanced scientific computing techniques. The model will be used in facilitating the understanding of data from the ongoing mission Juno. Moreover, we expect to contribute to China's gas giant exploration project in the near future by providing theoretical estimations for the mission design and science questions, etc.

As a space plasma physicist, I am also a fan of magnetohydrodynamics (MHD). The most fascinating question I would like to address is whether we can use basic plasma theory (e.g., MHD) to simulate the whole solar system. This is basically our foundation for deep space mission design – we can tell where to go and what to explore using theory and algorithms.

Visit the website of Dr Zhang:
https://www.binzh.net

View the full versions of the self-introduction of our young scientists
https://bit.ly/3qEZ4oK

Chemistry

Professor Xiang David LI
Professor of Department of Chemistry

2019 NSFC Excellent Young Scientists Fund (Hong Kong & Macau)
2018 CAPA Distinguished Faculty Award from Chinese-American Chemistry & Chemical Biology Professors Association (CAPA), USA

Research areas:
- Epigenetics
- Protein Post-translational Modifications
- Protein-Protein Interactions
- Chemical Proteomics
- Drug Target Identification

'My research is at the interface of chemistry and biology. My lab develops chemical approaches to address key questions in epigenetics, a new and exciting research area linking multiple hereditary and environmental impacts on our health. The findings from our research will ultimately improve our understanding of human diseases (e.g., cancer) linked to errors in epigenetic processes and may lead to new and improved therapeutic strategies.'

Website of The Laboratory of Chemical Epigenetics:
https://www.xianglilab.com/

Chemistry

Dr Jinyao TANG
Associate Professor of Department of Chemistry

2021/22 Research Fellow Scheme, Research Grants Council

Research areas:
- Novel nanorobot and artificial nanomotors
- Develop new energy nanomaterials and nanodevices

'We want to explore nanorobot-based functional materials where the material is composed of active and out-of-equilibrium nanomachines.'

Currently, nanomotor/nanorobotic research has grown into a multidisciplinary field, where researchers realise nanorobots for complex functions such as drug delivery and smart medicine. On the other hand, with the development of nanotechnology, the boundary between machine and material starts to blur. We want to explore nanorobot-based functional materials where the material is composed of active and out-of-equilibrium nanomachines. Many novel properties, such as collective intelligence, active self-assembly, and self-healing, are expected for this active functional material, where many applications ranging from high-performance thermal transport, color-shifting materials, and on-demand lubrication can be explored. We hope this research is merely a starting point for a fascinating new class of materials.

Website of Nanomaterial Research Group:
https://bit.ly/3C6UNxe

Chemistry

Dr Junzhi LIU
Assistant Professor of Department of Chemistry

2021 NSFC Excellent Young Scientists Fund (Hong Kong & Macau)
2020 Early Career Award, Research Grants Council
2020 Selected for the Early Career Advisory Board for *Chemistry - An Asian Journal*

'The most promising applications of our molecules lie in their molecular structures that can be used in creating advanced organic materials with tailored properties.'

My research interests focus on the design and synthesis of novel aromatic molecules. In addition to methodology and structure-oriented issues, the biggest challenge is identifying the applications for these new molecules. In my opinion, the most promising applications of our molecules lie in their molecular structures that can be used in creating advanced organic materials with tailored properties, including organic field-effect transistors (OFETs), organic light-emitting diodes (OLEDs), organic photovoltaic (OPV) solar cells, spintronics, etc., which require joint efforts from different areas.

My research group begun in 2019 and grew quickly into a strong multidisciplinary research team. Currently, my group is focusing on the research field of atomically precise synthesis of nonalternant topologies in graphene nanostructures, including 0D nanographenes, 1D polymers and 2D nanosheets (such as pentaheptite nanocarbons), to provide a route for accessing novel properties such as curvatures, open-shell characters, and new electronic functionalities for applications in organic devices. We also focus on the atomically precise synthesis of 3D topological molecular carbons. In addition to the basic research, we try to bridge the gap between the fundamental framework and its practical applications and promote the transformation of laboratory research results into realistic productivity, which can serve the economic and social development of Hong Kong, Greater Bay Area and Mainland China.

I expect that I can become a top key player in the field of nonalternant topology and 3D nanocarbons in the next five years. I hope that my team can accomplish the atomically precise fabrication of pentaheptite through the bottom-up method in five to ten years, which will herald a new era for 2D and carbon materials. For sure, there is no doubt that we need to work very hard towards this goal.

Website of Topological Molecular Nanocarbons Laboratory:
https://www.liulabhku.com

'The self-assembly of colloidal particles a few hundred nanometers in size is a promising approach to construct materials for the era of big data, increasing the efficiency of data processing, transportation, and storage.'

Chemistry

Dr Yufeng WANG
Assistant Professor of the Department of Chemistry

2020 NSFC Excellent Young Scientists Fund (Hong Kong & Macau)
2019 Croucher Innovation Award, The Croucher Foundation

I am a colloidal scientist working on colloids, tiny particles 1/100th the size of human hair. Colloidal particles not only can be found in everyday items such as paint, milk, glass and porcelain but are also crucial building components for constructing functional materials with advanced photonic, optical and mechanical properties. Unlike atoms and molecules, which have a predictable way of arranging themselves, colloids are uniformly sticky across their spherical surfaces. They assemble in nonspecific ways, making it difficult to design and assemble three-dimensional (3D) structures from these particles. To tackle this problem, I have developed a strategy to create colloids with valence, which are particles with surface patches so that they assemble into predictable structures comparable to how atoms combine to form molecules. This work gives scientists tremendous flexibility to design three-dimensional structures and materials, for example, light-weighted materials with open structures.

In five years, my goal is to establish a series of new colloidal platforms that allow us to tackle the most pressing challenges in colloid science or materials science in general. In the longer term, we wish to witness the real applications of the colloidal materials we develop. These include colloidal painting that shows tunable colour without organic dyes, colloidal robotics that carry therapeutic agents to treat diseases, colloidal crystals that reconfigure, or even microchips based on colloids and light. Because colloids have been employed as models to study fundamental physics, our systems will also help elucidate the crystallisation process and phase transitions.

Website of Complex Soft Materials Laboratory:
http://wanghku.weebly.com

Mathematics

Dr Zhiwen ZHANG
Associate Professor of Department of Mathematics

2016 HKU Overseas Fellowship Award
2011 Best PhD Thesis Award, Tsinghua University

'I am interested in studying deep learning methods for solving high-dimensional PDEs and stochastic dynamical systems in the next five years.'

Since I joined HKU, I have built my own research programme and made significant progress in several new areas, including structure-preserving schemes for computing effective diffusivity and computational methods for Schrodinger equations in the semi-classical regime.

Computing effective diffusivity for particles moving in chaotic and stochastic flows is a fundamental problem in studying the diffusion enhancement phenomenon in fluid advection, which is of great theoretical and practical importance. Many existing works use numerical methods (e.g. finite element methods and spectral methods) to solve a convection-diffusion type corrector problem to compute effective diffusivity but this becomes extremely expensive when the diffusion coefficient is small and/or flows are in 3D space.

I developed robust structure-preserving schemes (which are Lagrangian particle methods) to compute effective diffusivity for chaotic flows (including 3D ABC flow and Kolmogorov flow) and provided a sharp and uniform-in-time error estimate for the numerical schemes. My work is the first one in the literature to develop Lagrangian particle methods to compute effective diffusivity in 3D chaotic flows. I also developed stochastic structure-preserving schemes to compute effective diffusivity for stochastic flows, which is more challenging and interesting.

In recent years, deep learning methods have achieved unprecedented successes in various application fields, including computer vision, speech recognition, natural language processing, audio recognition, social network filtering, and bioinformatics, where they have produced results comparable to and in some cases superior to human experts. Motivated by this exciting progress, there is increased new research interest in the scientific computation community where researchers apply deep neural networks (DNNs) based methods for scientific computation, including approximating multivariate functions and solving differential equations using the DNNs. This is a fascinating research area where new and exciting research results come out every day. However, there are several issues that remain open. For instance, we do not get the convergence rate for the DNN method and we have little understanding of the parameter space of the DNN. In addition, the issues of local minima and saddle points in the optimisation problem are highly non-trivial.

In the next five years, I am interested in studying these issues about deep learning methods for solving high-dimensional PDEs and stochastic dynamical systems.

Learn more about the research of Dr Zhang:
https://hkumath.hku.hk/~zhangzw/

'Most of the work of a mathematician is basically being stuck and banging your head against a wall 95-99% of the time, followed by an epiphany that makes it seem like the hard problem you've been working on is obvious. It's all worth it for the excitement of realising something new and stretching your mind in a new direction, though.'

Learn more about
the research of Dr Benjamin Kane:
https://hkumath.hku.hk/~bkane/

Mathematics

Dr Benjamin Robert KANE
Associate Professor of Department of Mathematics

2018 Outstanding Young Researcher Award, HKU
Research areas:
- Representations of integers by polygonal numbers
- Applications of regularised inner products for meromorphic modular forms
- Number theory and combinatorics

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https://bit.ly/3qEZ4oK

'I am particularly interested in performing numerical simulations to study the realistic structures and emissions of black hole accretion disks.'

Physics

Dr Jane Lixin DAI
Assistant Professor of Department of Physics

2021 NSFC Excellent Young Scientists Fund (Hong Kong & Macau)
2019 Sophie and Tycho Brahe Visiting Professorship, Niels Bohr Institute, Denmark
2018 Block Award, Aspen Center for Physics

I have been mainly working on black hole astrophysics and, in the past few years, focusing on an astronomical phenomenon called 'tidal disruption events'. In these events, stars are torn apart by the gravity of black holes, and very luminous flares are produced as the stellar materials are swallowed by them. Astronomers are very interested in these events since they can give us precious chances to observe the supermassive black holes, which are usually too dark to be seen. I have been developing theories and conducting numerical simulations to explain these events. I have proposed a 'unified model' giving a solution to one of the biggest puzzles in the field – why some such events shine brightly in optical wavebands while the others only shine in X-rays.

We 'theorists' often rely on numerical simulations to obtain more detailed results or deal with problems that are too complicated to be calculated analytically. One main project of mine is to develop and utilise a state-of-the-art numerical code to calculate how gas, radiation, and magnetic fields interact close to black holes under general relativity. This work allows me to calculate the structure and geometry of the gaseous accretion disks in accreting black hole systems such as tidal disruption events, X-ray binaries, and exotic transients.

I am particularly interested in performing numerical simulations to study the realistic structures and emissions of black hole accretion disks. For example, some black hole accreting systems also produce coronae, which are X-ray photons with fast variability in energy bands much higher than expected. Some accretion disks also eject a lot of materials and launch winds. All these important features are not yet captured in existing black hole accretion disk models. I hope to push forward the theoretical understanding in this area and test my theoretical work with new observations from next-generation telescopes.

Visit the website of Dr Jane Dai:
https://bit.ly/3m3vHdb

'In reality, after sweat and tears, any theoretical research might just turn out to be flat wrong. But I believe that not all is lost. It is just a part of the process where one gains new and deeper understanding of the subject.'

Physics

Dr Shizhong ZHANG
Associate Professor of Department of Physics

2015 Croucher Innovation Award, The Croucher Foundation

My most important research accomplishment has been on the establishment and elucidation of universal relations in strongly interacting unitary Fermi gas and their implication for various transport properties of the system.

The most important question to me is understanding the collective behaviour of a many-body system when strong interaction is present. This is a general question that has applications in many areas of modern condensed matter and atomic/molecular physics. In my narrow area of expertise, I would like to tackle this question in the context of strongly interacting Fermi gas where experiments can be readily carried out. Specifically, I want to understand how to reliably compute various transport coefficients such as charge/thermal conductivity in the resonant limit of the atomic gas and if necessary, develop new techniques and frameworks for those questions.

The most important goal for me to accomplish in the next few years would be to understand in full detail some of the techniques and results that we are now investigating related to one-dimensional systems. It is a rich subject with a lot of background materials. Various different angles can be taken in that particular field and I believe it would be exciting to see and participate in how it develops.

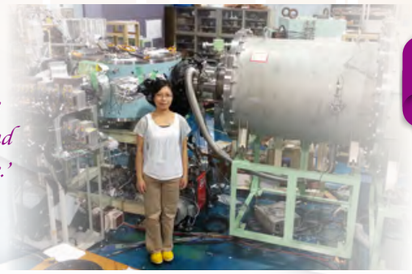
Currently, I have one graduate student and two postdoctoral fellows working actively with me. As collaborators in most of each other's endeavours, we often go through details of calculations together. I learn a lot from them.

I feel that in any theoretical research, it is a given that even though one might have a hunch as to how things will turn out, in reality, after sweat and tears, it might just turn out to be flat wrong. In fact, we recently had one such incident. But I believe that not all is lost. It is just a part of the process where one gains new and deeper understanding of the subject.

Learn more about Dr Zhang's research:
https://bit.ly/30B66Qt

'We aim to understand the novel features of nuclear forces and the synthesis of heavy elements; such knowledge is essential to elucidate the nature of many-body interactions and the origin of elements in our universe.'

Visit the website of
Nuclear Physics Laboratory:
https://www.physics.hku.hk/~nuclear/



Physics

Dr Jenny Hiu Ching LEE
Associate Professor of Department of Physics

2021 NSFC Excellent Young Scientists Fund (Hong Kong & Macau)

Research areas:
- Experimental nuclear physics for the studies of the nucleon correlations and the nuclear shell structure evolution
- Experimental techniques include direct reactions, in-beam gamma spectroscopy and beta-decay spectroscopy

The Swire Institute of Marine Science

Coastal Water Purifiers

7m² of a Hong Kong oyster reef filters almost one Olympic pool of water in a day

Key researcher: ***Dr Bayden D RUSSELL,*** *Associate Professor of School of Biological Sciences and Associate Director of The Swire Institute of Marine Science*

Often associated with food, oysters are less well-known for creating reef habitats that support coastal marine life.
Image Credit: ©Marine Thomas/Courtesy TNC

Historically, Hong Kong was home to thriving populations of shellfish reefs which dwindled over the decades owing to urbanisation, pollution and over-exploitation. These reefs act as both a food and income source as well as a supportive habitat for coastal marine life. In an effort to quantify the environmental benefits of restoring Hong Kong's lost oyster reefs, The Swire Institute of Marine Science (SWIMS) and The Nature Conservancy (TNC) jointly made a breakthrough discovery that a single Hong Kong native oyster *(Magallana hongkonensis)* alone can purify up to 30 litres of water per hour in summer. It was also reinforced that oyster reef habitats nurture large portions of our intertidal biodiversity and revitalising them can potentially increase the production of commercially valuable fish and crabs.
The team hopes that with the added advantage of high natural recruitment rates in Hong Kong, this research paves a sustainable path to local oyster reef restoration where it will not have to rely on transplanting hatchery-reared oysters into the wild as in many parts of the world.

香港曾是貝類礁蓬勃生長的地方，牠們為沿岸海洋生態提供豐富的食物及棲息地。惟因受過度開發、沿岸填海及污染等多種因素影響，貝類族群於過去 150 年間急劇減少。為了評估修復消失蠔礁對海洋環境的價值，太古海洋科學研究所及大自然保護協會進行共同研究，發現一隻香港蠔在夏天每小時可過濾高達 30 公升水，而蠔礁亦能為泥灘海岸培育出多樣生物物種，因此修復蠔礁能大大增加本地具商業及休閒價值的魚類及蟹類產量。他們亦同時發現本地蠔類的自然補充率很高，意味毋須依靠人工養殖蠔苗亦有機會修復本地蠔礁。

Learn more: https://bit.ly/3l0CGBT

Low public awareness and wild harvesting of mussels and oysters remain the biggest challenges to their ecological restoration.
Image Credit: ©Karsten Heinrich/Courtesy TNC

Oyster reefs in Hong Kong.
Image Credit: ©Kyle Obermann/Courtesy TNC

Image Credit: DnDavis/ Shutterstock.com

Biological Sciences

Wealth Inequality

revealed to fuel global wildlife trade

Key researchers: ***Professor David DUDGEON*** *(left),* *Emeritus Professor of School of Biological Sciences, HKU and* ***Dr Jia Huan LIEW,*** *former Postdoctoral Fellow of School of Biological Sciences.*

It is commonly assumed that the wide wealth gap exacerbates global wildlife trade as low-income economies are compelled to export wildlife products to meet the growing demands of wealthy countries' consumers. The concerted efforts of a group combining ecologists from HKU's School of Biological Sciences recently corroborated this premise. Analysing over 20 years of legal wildlife trade data, the team underlined the significant inequalities in socioeconomic well-being between exporters and importers of wildlife goods. In prominent trade partnerships, importers' per capita GPD was about 8-20 times higher than that of their export counterparts.
Greater wealth inequality in a post-pandemic world coupled with the positive correlation found between wealth inequality and the extent of the global wildlife market may have important implications on the international trade of wildlife products in the future. One take-home message of this research stresses the responsibility of affluent consumers to curb their demand for animal products, alongside encouraging governments to manage the trade with minimal endangerment to wildlife populations and the communities dependent on them as a source of protein or livelihood.

Learn more:
https://bit.ly/3zOULcd

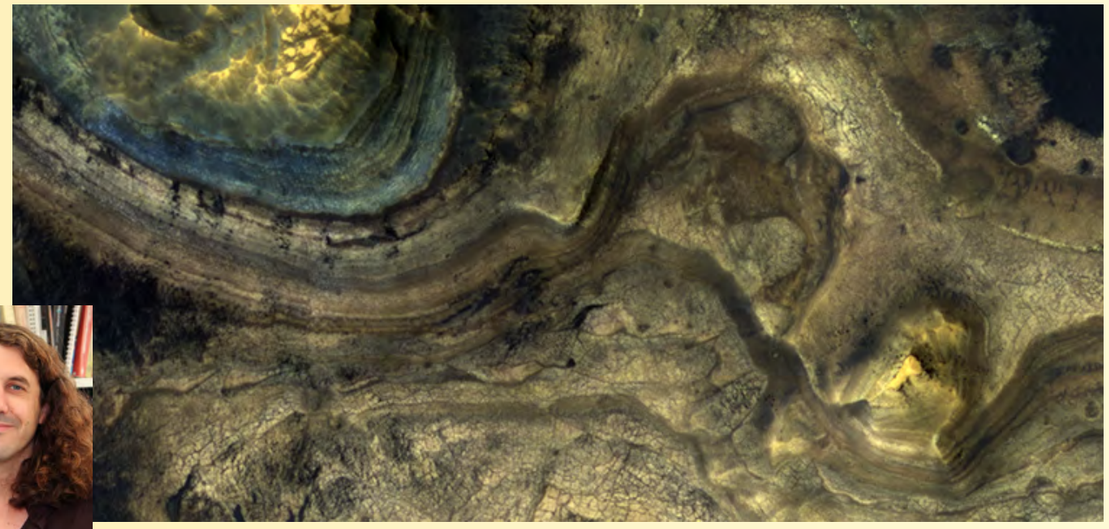
港大生物科學學院的研究團隊，透過分析全球在過去 20 年的野生動物貿易數據，印證當全球貧富差距擴大，國際野生生物貿易亦會相應地擴大及增長，並危害野生物種的生存。研究顯示，野生動物產品的出口和進口國之間有着明顯的貧富差距，進口國在各項社會經濟指標中表現都較好，其普遍人均生產總值是入口國的 8-20 倍不等。儘管近年爆發的新冠疫情令部分國家加強監管野生動物貿易，但也可能同時令國際間的貧富差距加劇，導致國際野生動物貿易有機會在疫情過後反彈增長。因此，團隊呼籲富裕國家應以降低消費者對野生動物產品的需求為目標，因為這比起全面禁止捕獵或採伐野生生物，更能避免過度打擊一些依靠這類貿易為生的群體。

Earth Sciences

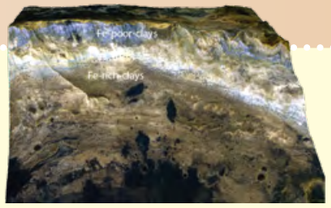
Breakthrough evidence for a reduced atmosphere on Ancient Mars

Key researchers: ***Dr Joe MICHALSKI,*** *Associate Professor of Department of Earth Sciences and Deputy Director of the Laboratory for Space Research (LSR), and* ***Mr Jiacheng LIU,*** *PhD student.*

At present, both Earth and Mars have oxidising atmospheres which cause iron-rich materials to react with oxygen and develop rust. However, this was not always the case in our planet's evolution as Earth transitioned from being a reduced planet to an oxidised one, thanks to the genesis of life and photosynthesis. Earth scientists at HKU succeeded in providing physical evidence that such an atmospheric transition occurred in early Mars as well, a hypothesis that had previously only been deduced from mathematical models.
Using infrared remote sensing and spectroscopy, the geologists uncovered the mineralogy and geochemistry of ancient rocks on the Martian surface. The chemical weathering pattern on them indicated that they had been exposed to reducing conditions, similar to observations on Earth's oldest rocks. This finding could have strong overtones for researchers' pursuit of life on ancient Mars.



The blue-toned rocks in the upper-left of the image are depleted in iron because it was removed during weathering on ancient Mars. This is geological evidence that iron was lost from the rocks in reduced conditions.



A 3-dimensional view of weathered bedrock shows the exposure of iron-rich red rocks beneath Fe-depleted blue-toned rocks in a crater wall.

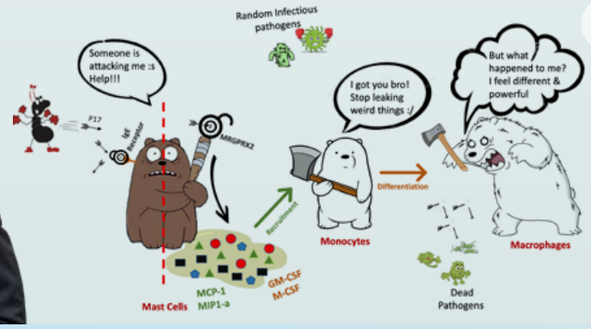
約 25 億年前，地球的大氣是還原性的，即地表並沒有鐵銹痕跡。但在生命的演化下，光合作用產生大量氧氣，使地球逐漸變成氧化性行星，此轉化過程也被稱為大氧化事件。最近，地球科學系和太空研究實驗室發現火星也可能曾經歷過大氧化事件。研究團隊利用高光譜遙感技術，分析火星地表物質的分子振動，將火星高光譜遙感數據與實驗室所收集的光譜數據進行詳細對比，發現火星地表露出的古老岩石曾經歷還原性的化學風化，顯示早期火星確實存在還原性的大氣環境。

Learn more:
https://bit.ly/38R4gvx

Biological Sciences

From ant bites to Allergy Safe Drugs: unravelling a novel pseudo allergic receptor pathway

Key researchers: ***Professor Billy CHOW*** *(right),* *Professor of School of Biological Sciences and* ***Dr Karthi DURAISAMY****, Postdoctoral Fellow at PhrmaSec, School of Biological Sciences.*



Cartoon depicting the overall pathway involved in MRGPRX2 mediated monocyte recruitment and differentiation. P17 activation of MRGPRX2, but not IgE receptor in mast cells resulting in cytokine releases (MCP-1, MIP1-α, GM-CSF and M-CSF) and subsequent monocyte recruitment and differentiation.

Professor CHOW's research team joined hands with researchers from INSERM and Institut National Universitaire Champollion in France to identify and demonstrate a novel small peptide isolated from ant venom that can initiate a novel immune pathway via a pseudo-allergic receptor MRGPRX2. The study showed the new immunomodulatory effect of the lesser-studied receptor. The team's findings provide insights into MRGPRX2's functions which in turn enhances the understanding of pseudo allergic mechanisms amongst the scientific community. This scientific advancement aids the development of drugs without side effects and antagonists that may help allergic reactions. Observing nature and its biodiversity inspires the HKU laboratory to pursue scientific innovations and continue acting as a platform for translating basic biology into novel drug discoveries. It is hoped that this abundantly-available ant venom (P17) could be exploited for inflammatory disorders and cancer therapy as well.

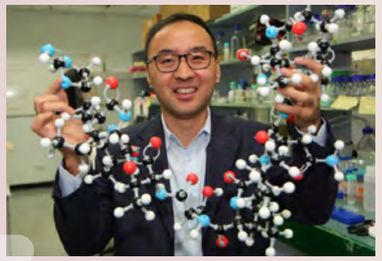
Learn more:
https://bit.ly/3l381Uo

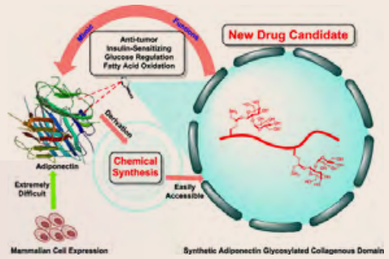
現時，科學家對偽過敏受體 MRGPRX2 在假性過敏反應中的功能了解仍然非常有限。生物科學學院與法國的專家團隊合作，成功從螞蟻毒液中分離出新型小肽——此肽可以通過 MRGPRX2 激活一個前所未知的免疫反應途徑。這是首次有研究團隊證明 MRGPRX2 介導的肥大細胞活化，此反應能夠募集單核細胞並將其轉化為巨噬細胞，並清除病原體。研究結果將有助開發一些全新抑制過敏反應的拮抗劑，以及針對炎症和免疫疾病的新藥物。最後，研究團隊相信只要對這些肽作出微調，便可用以殺死病原體，並不會產生任何副作用。

Chemistry

Promising novel synthetic biotherapeutics for Obesity-Related Diseases

Key researchers: ***Professor Xuechen LI*** *(as shown below),* *Professor of Department of Chemistry, Faculty of Science and* ***Professor Yu WANG****, Professor of Department of Pharmacology and Pharmacy, LKS Faculty of Medicine.*





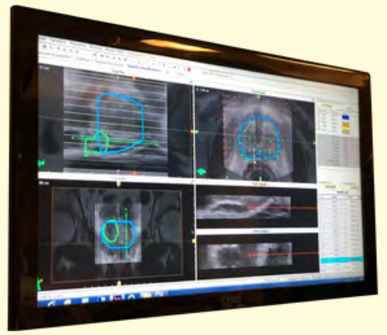
This finding could facilitate using the synthetic glycopeptide as a potential adiponectin downsized mimic supplementary in clinical treatment.

Despite the prevalence of obesity in our world today, its prevention and treatment using adiponectin – a major player in the pathogenesis of obesity, cancer and metabolic diseases, has been hampered by the obstacles in human production of the hormone. Seven years of dedicated research by two teams from the Department of Chemistry and the Department of Pharmacology and Pharmacy yielded fruitful results in developing synthetic glycopeptides which can mimic the bioactivity of adiponectin to inhibit tumor growth, insulin resistance and metabolic syndrome.

Now equipped with the capability to readily produce this synthetic compound, the researchers look forward to venture out and translate these findings from their mouse models into real-life clinical applications. This could open doors to new drug developments, including for type 2 diabetes, hypertension, coronary heart disease, stroke, chronic kidney disease and even cancer.

脂聯素補充療法向來都是醫學界致力尋求、用以預防及治療癌症和代謝病（尤其針對肥胖症患者）的良策，但由於無法大量生產脂聯素，令其臨床應用受阻。經過七年的努力，理學院化學系以及李嘉誠醫學院藥理及藥劑學系的研究團隊，共同研發出一種具有抗腫瘤、胰島素增敏和保肝活性的合成生物藥物，可有效模擬脂聯素的生物活性。研究團隊相信此模擬藥物能通過化學方法合成而輕易獲得，為脂聯素補充療法的臨床治療打開了機會之門。

Learn more:
https://bit.ly/3tp2GdU



The proposed framework has been applied in Stanford Medical Center
Image Credit: Dr Lequan Yu.

Statistical & Actuarial Science

Automatic prostate lesion segmentation in MRI Images with AI technology for radiation therapy

Key researcher: ***Dr Lequan YU,*** *Assistant Professor of Department of Statistics and Actuarial Science*

Radiation therapy is a commonly used treatment manner for prostate cancer.
Image Credit: Serafino Mozzo/shutterstock.com

Radiation therapy is a commonly used curative treatment for prostate cancer. In standard radiotherapy planning procedure, detection and delineation of prostatic lesions from multiparametric magnetic resonance imaging (mpMRI) images are crucial to integrate boosts to the intraprostatic lesions for improving the treatment effect. However, manually contouring the lesion is labour-intensive and time-consuming, and the accuracy highly depends on the experience of the radiation oncologists with interobserver variations.

Dr Lequan YU, teamed up with the research team at Stanford University School of Medicine, has developed a deep-learning-based system for intraprostatic lesion segmentation in mpMRI images, contributing to the clinical practice of boosting intraprostatic lesions during radiation delivery and improve the intraprostatic lesion delineation accuracy. This system has been applied in weekly brachytherapy procedures at Stanford Medical Center. Up to now, more than 80 patients have been treated with integrated boosts to intraprostatic lesions.

放射治療是治療前列腺癌常用的方法。為設計有效的放療計劃，病者必須透過多序列磁力共振掃描（mpMRI）準確無誤地勾畫出前列腺病變區域。然而，手動繪製病變輪廓既耗時又耗力，其準確性亦非常視乎放射腫瘤學家的經驗而定。

于樂全博士與美國史丹福醫學院的研究團隊合作開發了一種運用了人工智能「深度學習」技術的 mpMRI 掃描圖像系統，能準確地分割出前列腺病變區域，大大提高了勾畫病變區域的準確性。現時，史丹福醫學中心已將這系統應用於「近距離放射治療」的流程中；截至目前為止，已有超過 80 名相關患者應用此系統。

Physics

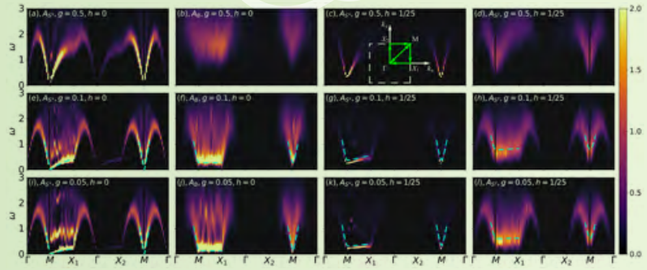
First-year physics PhD students obtained the Higgs Mode via dimensional crossover reveals importance of dimensions in many-body systems

Key researcher: ***Dr Zi Yang MENG*** *(middle), Associate Professor of Department of Physics;* ***Dr Zheng YAN*** *(right) and* ***Mr Chengkang ZHOU*** *(left) are in his research team.*

Learn more:
https://bit.ly/3DVYXcN

Our current understanding of the physical laws for mass are primarily influenced by the Anderson-Higgs mechanism (aka Higgs mode), explaining from subatomic particles such as the 'God particle' Higgs boson to superconducters and magnets in condensed matter physics and quantum material research. Yet, due to the overdamping property in the material, it is a struggle to observe the Higgs mode in it, especially via a dimensional crossover approach.

A first-year PhD student, **Mr Chengkang ZHOU** along with researchers from HKU, the Sun Yat-Sen University, the University of Michigan and the University of Utah, has achieved the rare success of revealing the clear presence of the Higgs mode in a quasi-1D quantum magnetic system. Results from this study paint a more detailed picture of how dimension matters in the condensed material and stimulate the development of next-generation quantum materials.



The spectra of the Goldstone mode, the Higgs mode, and the scalar mode changes with the coupled spin chains that tends to a quasi-1D limit. The first and the third columns are for the Goldstone mode. The second tells the scalar mode while the fourth is the Higgs mode.

在凝聚態物理和量子材料研究領域上，「上帝粒子」，亦被稱作希格斯玻色子，是超導材料和磁性材料實驗中的重要現象。由於希格斯模式具有過阻尼的特性，導致它在從高維到低維的跨維度過程中難以被清晰觀測得到。從 2020 年起，港大物理學系聯同中山大學、密歇根大學及猶他大學的研究團隊成功設計及觀察一個能實現跨維度過程的耦合自旋鏈模型，並在準一維量子磁系統中發現希格斯模式的存在。這些發現不但有助於我們獲取材料模型的關鍵參數，並讓我們認識維度對凝聚態材料的重要性，以及其如何影響量子系統。

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Law and science interdisciplinary electives	–	–	–	12	12	Law and science interdisciplinary electives
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- Environmentalists specialising in animal and environmental law
- Researchers or academics in the fields of science or law

Research laboratories of Department of Chemistry admitted to the

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Delivering cutting-edge research with an impact on the well-being of mankind

As a major initiative of the Innovation and Technology Commission, HKSAR to develop Hong Kong as the hub for global research collaboration, InnoHK involves the establishment of world-class research clusters at the Hong Kong Science Park with research laboratories set up by world-leading researchers.

Health@InnoHK and AIR@InnoHK are the first two research clusters established progressively, focusing on health-related technologies and the development of Artificial Intelligence and Robotics technologies respectively.

Two research laboratories led by two top-notch researchers from the Department of Chemistry have been admitted to the above programmes and join forces with their peers from world-class universities all over the world, to conduct collaborative research projects that will change human life.

The Laboratory for Synthetic Chemistry and Chemical Biology – making advanced cancer become a treatable chronic disease

A tripartite alliance involving The University of Hong Kong (HKU), Peking University and Imperial College, UK, has embarked on a research path to find cure for advanced and metastatic cancers. The Laboratory for Synthetic Chemistry and Chemical Biology is a 5-year programme led by **Professor Chi Ming CHE**, Head of Chemistry and the Zhou Guangzhao Professor in Natural Sciences at HKU. The projects under the programme are to develop innovative, leading-edge interdisciplinary research that connects Chemistry, Molecular Biology and Clinical Oncology. It has been admitted to the Health@InnoHK programme with a projected funding of HK$502.3 million and a laboratory area in the Hong Kong Science Park.

At the Laboratory, four interdisciplinary programmes are conducted, namely Synthetic Chemistry, Chemical Biology of Natural Products and Chinese Medicine, Metal Anti-cancer Medicine, Diagnostics and Theranostics, and Multi-Omics and Innovative Analytical Technologies.

Professor Chi Ming CHE

Finding the right drugs to improve the survival outcome of cancer patients

Professor Che steers the direction of the project.

Supported by substantial funding, top scientists from the three universities are committed to discovering new relatively non-toxic drugs with high efficacy for treating cancer, with an initial focus on those plagued by liver cancer, nasopharyngeal carcinoma and lung cancer.

Currently, chemotherapy remains indispensable for patients at late stages of cancer disease. Besides the debilitating consequences brought by the treatment, it cannot fully eliminate the disease except prolonging the patient's life for a limited time.

As the leader who steers the direction of the projects, Professor Chi Ming Che sees the pivotal value of developing new targeted chemotherapies that offer a kind of cure for those diseases in the long run. 'We are working to find the right drugs from natural medicine and products as well as unnatural synthetic compounds to reduce the side effects of chemotherapy. But there comes the question, how can we develop drug candidates targeting the complete removal of the cancer cells/cancer stem cells, so as to prevent recurrence and to improve the survival outcome of cancer patients say by five to ten years?'

The project aims to develop innovative, leading-edge interdisciplinary research that connects Chemistry, Molecular Biology and Clinical Oncology.

Genetic changes along with cancer progression, resistance to targeted drugs and immune escape of tumors are some of the challenges posed to cancer treatment. Yet, he remains optimistic, counting on the expertise and equipment facilities offered by a world-class laboratory. 'We can use many different ways to study and test drugs/medicines including tradition Chinese medicines; we carry out studies on patient-derived cancer organoids and humanised mice.'

The East-West Collaboration bringing hope to cancer patients and their families

Professor Che is confident of achieving a breakthrough in about five years' time as he draws on the efforts of a strong team of multi-disciplinary researchers at the Laboratory, set up by the alliance at Hong Kong Science Park. The local team comprises of young, established researchers from the chemistry, molecular biology and biomedical departments at HKU.

Opening up to collaborate with talented and resourceful teams across the world further fuels the innovative research through fostering talent exchanges. 'Peking University's medical faculty is home to a centre of precision medicine, and known for its multi-omic technology and advanced mass spectrometry, whereas Imperial College's strength lies in chemical biology and metal diagnostics,' said Professor Che.

Overall, he is grateful for having the chance to work on meaningful research offering hope to cancer patients and their families, hope not just for survival but at least a better quality of life by reducing side effects from chemotherapy. 'It is best to have a drug that can at least prolong life, preventing relapse in five years. It might not be a total cure for cancer, but at least we can kill the bad cells temporarily,' he remarked.

Full story
https://bit.ly/3vxcF1J

Video story of Health@Inno
https://bit.ly/3Cb2Ybb

The Hong Kong Quantum AI Lab — Using AI to make a smart use of renewable energy

The Hong Kong Quantum AI Lab, also known as The Centre of Machine Learning for Energy Materials and Devices, is a multi-disciplinary programme that combines big data, machine learning, computational science and experiment calibration to discover new energy materials and devices, in particular, organic light-emitting diode and solid-state lithium-ion battery.

Professor Guanhua CHEN from Department of Chemistry is the Director of the Lab, as well as the Lead Principal Investigator. The Lab has been admitted to AIR@InnoHK over a five-year period and provided a laboratory area in Hong Kong Science Park. It aims at developing a computational platform integrating AI, computational science and experimental data to discover new materials. The Lab has joined forces with California Institute of Technology in using artificial intelligence to widen the use of renewable energy and create new-generation materials for organic light-emitting diodes (OLED).

Professor Guanhua CHEN

The Centre is poised to establish Hong Kong as a global hub of materials science research, development and commercialisation.

Predicting the precise properties of next-generation materials

'The immediate goal is to develop via the platform the next generation of materials for blue OLED, and solid-state lithium battery,' said Professor Chen, 'The Centre is poised to accelerate the discovery and application of next-generation materials for OLED and solid-state lithium battery with data science, and establish Hong Kong as a global hub of materials science research, development and commercialisation,' Professor Chen added.

It has been his longstanding goal to design molecule materials on computers. And working with data scientists helps fill the gap in the discovery of next-generation materials.

'AI can help fill the gap. Deep learning requires a massive amount of data, and yet, experimental data is expensive to obtain. Is it possible that we use a limited amount of experimental data? The platform that the Lab is building is to resolve this problem.' Professor Chen is optimistic that the Lab will be able to achieve a breakthrough in a few years' time .

Carrying out more systematic research

The imminent task now is to set up the platform for screening 'all sorts of materials'. Professor Chen hopes their effort will lead to the discovery of blue OLED materials with improved efficiency and life span. Another central mission of the Centre is to develop a solid-state lithium-ion battery that can allow for safer, higher energy density power storage – described by Professor Chen as a missing link of the third energy revolution. 'The liquid lithium-ion battery currently used is not safe for massive storage. We are using a new approach. I strongly believe that computational scientists working with data scientists and experimentalists can finally solve the problem.'

The immediate goal is to develop via the platform the next generation of materials for blue OLED, and solid-state lithium battery.

The reason for his high hopes is that he is one of the first scientists in the world to introduce AI into quantum chemistry. The Lab, he says, is in an advantaged, unique position with its computational platform and AI, and sufficient support not seen anywhere else. 'I am very excited about this opportunity,' he noted.

On the other hand, his Lab is ready to tap industrial expertise. It has forged alliances with major companies, including Guangdong Algaia Optoelectronic Materials and TCL Corporation to facilitate knowledge transfer, commercialisation of patents and provide early investments for its spin-offs, it has teamed up with the Hong Kong X-Tech Startup Platform.

Professor Chen acknowledges fresh insights have been brought by communicating with the industry and understanding the challenges they face. 'For the past year, I have spent much effort to understand what they want. The problems we see may not be directly relevant to the industry. We academics have very nice tools, methodologies, and yet we have to modify our research according to the needs of the industry.'

Full story
https://bit.ly/2Z28aQE

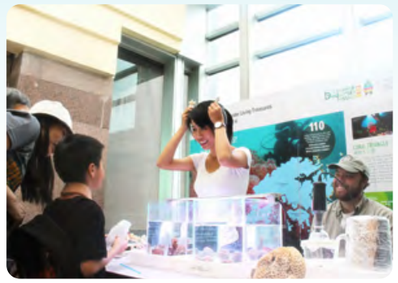
Video story of Air@Inno
https://bit.ly/3qIMViN

An innovative approach to revive lost coral havens

"Books have always said it takes decades to destroy the reefs, but in reality they can just be gone in the blink of an eye."

Vriko Yu
The Co-founder & CEO of archiREEF
PhD student of School of Biological Sciences

We have always been taught that habitat loss – a known threat to our planet and its biodiversity – occurs gradually over many years. PhD student **Vriko YU** used to share that belief but was alarmed to witness first-hand a patch of coral off Hoi Ha Wan Marine Park disappear in just two months. Coral reefs are the 'tropical forests of the sea', known for their rich biodiversity which provides a highly complex habitat to support whole ecosystems of fish, plants and invertebrates.



Vriko participates in conservation education which promotes biodiversity literacy.

'Books have always said it takes decades for us to destroy the reef,' Vrkio recalls, 'but in reality, it can just be gone in the blink of an eye. That is when I started to think about what we can do to mitigate the impacts of climate change.'

Vriko's love for diving started in her undergraduate studies, where she likened the excitement of finding and identifying the many sea creatures to a game of Pokémon Go. 'What I like about diving is that I don't know what I would get to see, like catching Pokémon! Typically when we dive, we go to hotspots which are where corals are.' This made her realise that in order to continue conserving what we like to see underwater or foods we like to eat, first we need to rebuild the corals. 'They are the foundation,' she emphasises.

This drive to protect coral reefs led Vriko to start her own social enterprise, archiREEF – an environmental social enterprise offering a one-stop solution for impact changers at corporation or government levels, or even individuals that want to be involved in making a difference.

Seamlessly blending manmade supports into nature

Vriko explains that traditional reef restoration uses more primitive materials like metal or concrete as a substrate for the coral, which does not mimic the natural environment well. To provide a better alternative, Vriko worked on producing 3D-printed reef tiles as part of her PhD research project at HKU, supervised by Dr David BAKER, Associate Professor at School of Biological Sciences.

The reef tiles that mimic the surface of brain corals have seen much success. They yielded a four times higher survivorship of local 'super-corals' – the nickname given to corals capable of growing in the harsh Hong Kong waters – as well as boasted significantly more commercial fishes and a higher biodiversity of coral-associated invertebrates on-site. Most excitingly, Vriko and her team even witnessed an apex predator making its home and laying eggs in the restored coral habitat.

'The first time I saw the female cuttlefish, it was really exciting! She was huge and looked like a spaceship, but suddenly she flattened herself to catch a prey. The second time we saw her, we thought she was sleeping but when we got closer, we realised she was laying eggs under the tiles!' Vriko reiterates the ultimate goal of restoration is to bring entire ecosystems back to their healthy states. This one charismatic cuttlefish residing and completing her life cycle in the reef tiles is a symbol of hope that coral reefs can be restored, along with their lost biodiversity recovered.

Vriko dived into the sea and placed the reef tiles on the sea floor with her own hands.
Photo credit: Victor Lau

Growing into the international arena

To further promote coral reef conservation in the region, Vriko is currently serving as a non-official member on the Country and Marine Parks Board of The Government of HKSAR, as well as the Education Committee for WWF, where she shares her expertise on conservation with other stakeholders.

Yet, the protection of coastal reefs is a concern not only locally. Neighbouring regions also have sought Hong Kong's support in this aspect. Vriko, who additionally serves as the Assistant Director and Eco Diver Instructor for Reef Check Hong Kong (RCHK), provides the necessary training alongside other volunteer instructors to ensure that their international counterparts too, are better equipped with knowledge on reefs and how to monitor their status.

The research project is a big success. Virko's team revisited the site lately and saw lots of marine life around the tiles – one of the cuttlefish moms even laid eggs under the tiles!

For those of you who wish to follow in Vriko's footsteps with a postgraduate degree, Vriko is very satisfied with the support that HKU provides PhD students such as herself. 'I have to thank my supervisor, Dr David BAKER, for giving me the flexibility to decide what I wanted to do. It is not usual for students to have the autonomy to decide what they want to pursue, and have a supervisor fully supportive of them.'

With the additional help of travel grants, she was given opportunities to attend overseas conferences, gaining invaluable experiences outside of Hong Kong. One piece of advice she hopes all students can take is to be proactive. 'In HKU, anything is accessible if you are willing to be proactive to ask. There are always channels to help!' *(Article by Kengie TANG)*

Learn more about archiREEF:
https://archireef.co

View Interview with CNN:
https://cnn.it/3bgMQK3

Student Reporter

Kengie TANG
Science student ambassador
BSc student (major in Biological Sciences)

'I am grateful for the opportunity to sit down with such an inspiring, multi-talented individual and learn all about coral reef restoration in Hong Kong. Vriko's drive for conservation and change-making is a reminder for us all to take stewardship of our planet and protect our environment before it's too late!'

Students' Achievements

Miss Kanmani CHANDRA RAJAN, PhD candidate of The Swire Institute of Marine Science (SWIMS) and School of Biological Sciences, won the 'Constance Boone Award' for best student presentation at American Malacological Society virtual annual meeting 2021; the presentation was mainly based on her research journal about oyster biomineralisation under ocean acidification. Students' oral and poster contributions are evaluated based on the clarity of the presentation and the abstract, scientific merit, and the student's ability to answer questions concerning the presentation.

Details of the award: https://bit.ly/3umwiZW

Mr Mukesh KUMAR, the PhD student at School of Biological Sciences, won the Online People's Choice Award in 'HKU 3MT Competition 2021'. The title of his presentation was 'Why endure allergies when you can cure them?' In his research, Mukesh has designed, and developed novel drug molecules and tested them on human cells and animal models of allergies. Among these molecules, he found one drug molecule has not only reduced the inflammation and the scratching behaviors of the mice but also significantly inhibited the root cause of allergy. The research team led by Professor Billy CHOW identified the key to the allergic lock and opens the door to new therapeutic options for all of us to fight against allergy.

View his presentation: https://bit.ly/3kR7eHo

Mr Binlong YE, PhD student of Department of Earth Sciences, was awarded the Outstanding Paper Prize at a large planetary science conference organised by Chinese Geophysical Society. 500 papers were submitted this year, from which only 27 were selected to receive the award.

Mr Xuping YAO, PhD student from Department of Physics was awarded 'The 2021 Ovshinsky Student Travel Award' presented by the APS Division of Materials Physics at the 2021 APS March Meeting. The award is named after renowned American Scientist Stanford Ovshinsky, which is established to assist the career of student researchers, and has been endowed by the Ovshinsky family.

Miss Jasmine So Yee CHEUNG, our Chemistry undergraduate and a HSBC Innovation and Technology Scholar 2020, along with her team won the 1st Runner Up in the 'AI Future Tense – Pitching InnoTech Solutions' with their proposed AI speech therapy app that combined deep learning algorithms and AI technology, named 'Vera', which provides an affordable and convenient diagnosis along with personalised treatment for 3- to 8-year-olds with speech sound disorders. The competition organised by The Hong Kong Federation of Youth Groups (HKFYG) under the HSBC Future Skills Development Project hosted almost 60 different groups composed of tertiary students from across Hong Kong to generate impactful innotech solutions tackling social issues.

The expansion of

The Swire Institute of Marine Science

Marking the beginning of a new era in marine research

The Swire Institute of Marine Science (SWIMS) is an off-campus research and education facility under HKU Science.

A Plaque Unveiling and Opening Ceremony took place on July 28, 2021 at The Swire Institute of Marine Science (SWIMS) at Cape d'Aguilar Marine Reserve, celebrating its expansion and setting new milestones in marine biodiversity research.

Since its inception in 1990, SWIMS has long been a premier marine research centre driving our understanding of coastal marine ecosystems in Hong Kong and surrounding regions. Whilst earlier research relied on more field-based approaches, recent technologies have revolutionised marine biology. Three decades since its launch, it is an opportune time for SWIMS to modernise and expand its research capacity to provide HKU researchers with state-of-the-art facilities.

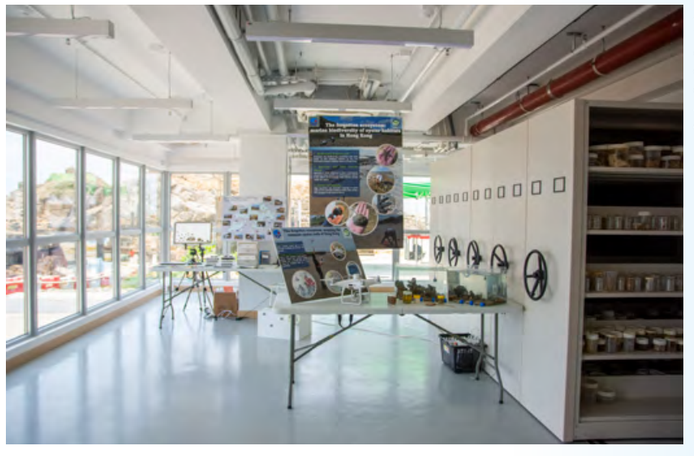
The officiating guests gathered to unveil the plaque for SWIMS' expansion. From the left: Professor Gray A WILLIAMS, Director of HKU SWIMS; Mr Merlin SWIRE, Chairman of Swire Pacific Limited; Professor Xiang ZHANG, President and Vice-Chancellor of HKU; Professor Matthew R EVANS, then Dean of HKU Science.

Modernised facilities and equipment

Forming an L-shape with the existing main building, the expansion and renovation comprise a clean laboratory, biodiversity centre and both indoor and outdoor seawater aquaria, providing state-of-the-art facilities for its growing body of new staff and research students. 'Through the addition of new facilities, SWIMS will be able to host more researchers from around the world and maintain its leading role in marine science research, while also catering to the growing interest in local marine ecology and biodiversity being developed by citizens in Hong Kong,' said Professor Gray A WILLIAMS, Director of SWIMS.

Riding on its re-opening, SWIMS also launches the 'Restoring Hong Kong's Whale' Campaign to recreate the fin whale skeleton, the symbol of marine conservation that has been sitting on the shore beside SWIMS for three decades. Badly damaged by typhoon Manghkut, the campaign will revitalise the icon and help support educational activities at SWIMS.

President Xiang Zhang interacting with researchers while visiting the Biodiversity Centre.



Biodiversity Centre – As part of the new structure, the centre will be a multipurpose space for public outreach and community engagement, a classroom for visiting school groups, and a compactus system that houses the SWIMS museum specimen collection. This collection is the most comprehensive for marine species in Hong Kong, and will continue to be used for research and educational purposes.

Aquarium – Expanded from the existing structure, containing approximately 50-60 individual tanks in different dimensions to accommodate species of different sizes. The aquarium is designed specifically to provide a controlled environment where lighting, temperature and CO_2 levels are adjustable for manipulating the environment according to the needs of different experiments.

Clean Laboratory – What used to be staff offices and storage space has been converted into a brand new, state-of-the-art clean facilities for molecular and physiology research. It provides a clean and dry environment for extracting DNA and performing molecular analysis using advanced equipment and physiological experiments.

View the full version:
https://bit.ly/2Yg4oTV

Details of the expansion:
https://bit.ly/3FLd3yB

Learn more about the Restoring Hong Kong's Whale Campaign:
https://bit.ly/3B4d9hQ

Video highlight of the opening:
https://bit.ly/3aGOXGU

Strive for biodiversity:

The first biodiversity museum in Hong Kong

The Hong Kong Biodiversity Museum (HKBM), the first museum in Hong Kong that is dedicated to biodiversity, is now open to public for visits. It strives to be a natural history museum promoting environmental education and appreciation of biodiversity, fostering its preservation as a part of mankind's natural heritage and by supporting scientific research on biodiversity, as well as increasing the biodiversity literacy of the public.

With over 10,000 specimens, HKBM hosts the largest and most comprehensive biodiversity collection within Hong Kong. Several of the species present, collected from the 1920s to 1970s, are unfortunately now considered as threatened and thus represent an important heritage to pass on to future generations. In addition to preserving these valuable specimens so that they can be studied and presented to the public, the work of the HKBM team includes the expansion of this biobank to better reflect our current knowledge about local and regional biodiversity.

An overview of the gallery of the HKBM

Visit the website of HKBM:
https://www.hkbiodiversitymuseum.org

Fundraising Campaign:
https://bit.ly/3lLn3jn

The museum is managed by a team of experts from the School of Biological Sciences, including Dr Benoit GUÉNARD, Aline MACHADO DE OLIVEIRA and YU Ho Him, Anders. The HKBM team is currently running a fund-raising campaign: Bare Bone Restoration, to restore damaged specimens and to expand the collection for education, conservation study and research, as well as to increase visitors' capacity by growing the team and organising more visits.

News

6901 Bachelor of Science programme has been conferred accreditation for its Environmental Science Major by the Hong Kong Institute of Qualified Environmental Professionals (HKIQEP), a local professional body established in 2015 to support environmental management in Hong Kong and monitor the quality of ongoing work in the environmental field.

Students on the accredited pathway will benefit from the fast-track towards obtaining HKIQEP's Professional Membership, with the number of work experience years needed post degree reduced to 5 years in lieu of the standard 10 years. Additionally, apart from the partial exemption in the Professional Assessment (Part 1), they will also be eligible for HKIQEP's student membership during their study period at HKU. This will facilitate students' interactions with practising, local environmental scientists through networking opportunities and professional development activities.

To graduate with the Environmental Science Major accredited programme, students will be required to take 7 specific advanced courses on top of their compulsory curriculum.

Detail of our accreditation: https://bit.ly/3aKFjCV

Times Higher Education (THE) World University Rankings have been released recently. Apart from the honour that HKU is being ranked overall 30th among global top universities, Faculty of Science is consistently performing well in the world-renowned scholastic ranking – **we are placed number 53 in Physical Sciences while our Life Sciences ranks 42nd** , a rise of six places in a year.

For details of THE World University Rankings by Subject 2022, please visit: https://bit.ly/39dpynj

Research Assessment Exercise (RAE) 2020 by the University Grants Committee (UGC) affirms **HKU Science's world-leading research positions**

Unit of Assessment (UoA)	HKU Science (Percentage judged to be "world-leading" (4*) and "internationally excellent" (3*))	Sector-wide average
Chemistry	**99%** (Highest in 4* in the UoA)	92%
Physics & Astronomy	**95%**	91%
Earth Sciences & Other Physical Sciences	**85%** (Highest in 4* in the UoA)	77%
Mathematics & Statistics	**82%** (Highest in 4* in the UoA)	77%
Biological Sciences	**62%**	61%

Faculty of Science continued to excel in the latest Research Assessment Exercise (RAE) 2020 published in May. Among the five Units of Assessment (UoA) to which HKU Science submitted, under the Panels of Physical Sciences and Biology, we outperform other local universities and achieve the highest percentage of 4* ratings in three UoAs including Chemistry, Earth Sciences and other Physical Sciences, and Mathematics and Statistics, affirming our world-leading position in the aforementioned fields (37% of all research submitted by the Faculty was judged to be world-leading (4*) by the RAE panel). More details: https://bit.ly/3FPBXwR

It is with deep sadness that we mourn for the passing away of Dr Stephen, Choi-Lai CHAN, our alumnus and former colleague of the Faculty of Science, on October 10, 2021 at the age of 81 in the company of his family. Dr Chan had been working in the Department of Mathematics for 34 years until he retired on 2002. He was also a founder and chair committee on HKU General Education (GE) in 1995. Under his supervision, over 200 courses and workshops in diverse areas were mounted between 1995 and 2000, with special emphasis on education of the whole person rather than mere transmission of knowledge and techniques. Obituary of Dr Stephen CHAN: https://bit.ly/3DRgdyY

Event highlights

2021 OCT 30

The HKU Virtual Information Day 2021 was successfully held on October 30. For more information about our new initiatives in our Science curricula, as well as other information about our science programmes, please **visit our One-stop platform for Science Undergraduate Admissions anytime** and plan your university studies ahead of time. More details: https://bit.ly/3n6ySzN

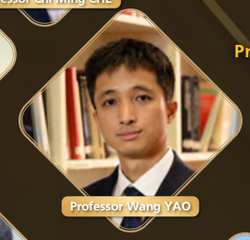
EXTERNAL AWARDS AND HONOURS

Professor Vivian Wing-Wah YAM, Dean of Science (Interim) and Philip Wong Wilson Wong Professor in Chemistry and Energy, was awarded the American Chemical Society (ACS) National Award – the 2022 Josef Michl ACS Award in Photochemistry, in recognition of her exceptional accomplishments in fundamental research in photochemistry.


Professor Chi Ming CHE

Professor Chi Ming CHE, Zhou Guangzhao Professor in Natural Sciences and Head of Department of Chemistry, was awarded the Silver Bauhinia Star (SBS) in 2021 Honours list, in recognition of his remarkable achievements and contribution to a wide spectrum of research areas in the chemistry discipline.

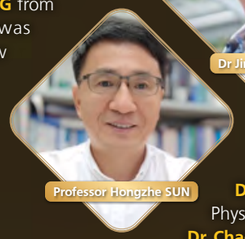

Professor Vivian Wing-Wah YAM


Professor Wang YAO

Professor Wang YAO won the 2021 Xplorer Prize, which is initiated by Tencent Foundation and aims to support young scientists in the fields of fundamental science and cutting-edge technologies.

Professor Hongzhe SUN, Chemistry & Norman and Cecilia Yip Professor in Bioinorganic Chemistry, as well as **Professor Wang YAO** from Department of Physics, were selected for Research Grants Council's Senior Research Fellow Scheme, while **Dr Jinyao TANG** from Department of Chemistry was selected for Research Fellow Scheme. In recognition of their research excellence, they were awarded a total of over HK$20 million in funding to facilitate and advance their research.

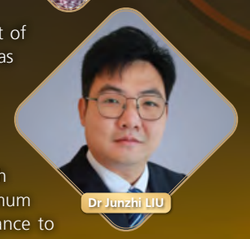

Dr Jinyao TANG

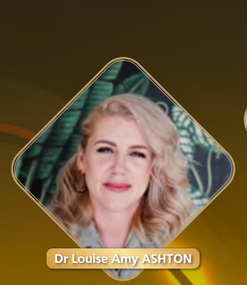

Professor Hongzhe SUN


Dr Jenny Hiu Ching LEE


Dr Lixin DAI

Dr Jenny Hiu Ching LEE and **Dr Lixin DAI** from Department of Physics, **Dr Junzhi LIU** from Department of Chemistry, as well as **Dr Chaogu ZHENG** and **Dr Louise Amy ASHTON** from School of Biological Sciences, have achieved outstanding results in the NSFC Excellent Young Scientists Fund (Hong Kong & Macao) for 2021, a prestigious fund under the National Natural Science Foundation of China of the Ministry of Science and Technology (MOST). Each project will receive a funding of RMB1.6 million over a maximum period of three years, in the form of cross-border remittance to directly support the researchers' work in Hong Kong or Macau.


Dr Junzhi LIU


Dr Chaogu ZHENG

Dr Louise Amy ASHTON

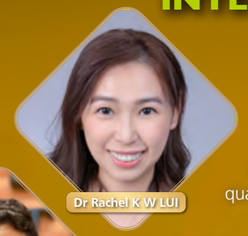
INTERNAL AWARDS

Dr Louise A ASHTON, Assistant Professor of School of Biological Sciences and her collaborators were awarded the Faculty Research Output Prize 2019-20 for their journal paper "Termites mitigate the effects of drought in tropical rainforest".

Professor Hongzhe SUN, Norman and Cecilia Yip Professor in Bioinorganic Chemistry & Chair of Chemistry and his research team, received the Faculty Knowledge Exchange (KE) Award 2021 for their distinguished contributions in the development of bismuth drugs for the treatment of microbial infections.

Faculty's Award for Outstanding Professional Services Staff went to **Mr Man Fai LEE**, Senior Clerk of Faculty of Science, for his extensive efforts to create a comfortable working environment for his Faculty colleagues, and his contribution towards various areas including undergraduate admissions, finance and facility management.


Professor Pauline CHIU


Dr Rachel K W LUI

Dr Rachel K W LUI, Senior Lecturer of Faculty of Science, was honoured with the Faculty's Award for Teaching Excellence 2020-21 for her dedication to high-quality teaching.


Mr Abdullah Nawabjan SHAIK

Professor Pauline CHIU of Department of Chemistry received the Faculty's Award for Teaching Innovations in E-learning 2020-21 for her remarkable efforts in enhancing students' learning experience.


Mr Man Fai LEE


Mr Thomas H T WONG

Mr Abdullah Nawabjan SHAIK, PhD student, School of Biological Sciences, as well as **Mr Thomas H T WONG**, MPhil Student, Department of Physics were awarded the Faculty's Excellent Teaching Assistant Award 2020-21 for their enthusiasm in providing teaching support in classes.

New Staff

Dr Haibo JIANG

Associate Professor of Department of Chemistry
Research Interests: bioimaging, cell biology and metabolism, bioengineering

I am very excited to join the Faculty. My research largely focuses on the development and use of advanced bioimaging methods to understand mechanisms of how molecules are transported and processed. My long-term goal is to create better diagnoses and therapeutics for human diseases based on our fundamental discoveries.

Dr Seungkyu LEE

Assistant Professor of Department of Chemistry
Research interests: reticular chemistry, porous crystalline materials, energy storage

I am very excited to join the team and start my new career in a beautiful city, Hong Kong! My research mainly focuses on inventing porous crystalline materials, including metal-organic frameworks and covalent organic frameworks, and studying their physical properties related to energy storage applications. My long-term goal is to establish a new class of materials with numerous structural and functional variations, inspiring many students and scientists worldwide. I'm looking forward to active collaborations with my new colleagues and students!

Dr Yuan CAO

Assistant Professor of Department of Statistics & Actuarial Science, and Department of Mathematics
Research Interests: machine learning, learning theory, high-dimensional data analysis, optimisation

I am very excited to join the Faculty of Science. My research focuses on understanding and advancing machine learning methods. Recently, I have been particularly interested in explaining how neural networks can be trained to fit the data, extract features, and make good predictions. Besides research, I like sports and music. I am looking forward to working together with the talented faculty members and students at HKU!

Dr Yating WANG

Assistant Professor of Department of Mathematics
Research interests: scientific computing and machine learning

It's my great pleasure to join the HKU science family and be a member of the department! My research mainly lies in multiscale methods and machine learning for the simulation of complex physical processes. I am dedicated to developing efficient numerical solvers and trustworthy physics-informed learning frameworks for scientific applications. Besides, I enjoy hiking and cooking in my leisure time. I am really excited to be part of this beautiful city and can't wait to explore this gourmet paradise.

Alumna granted Research Fellowship from National Science Foundation, US

Alumni Corner

Supporting the investigation of the nutrients exchange between symbiotic partners

Symbiotic relationships in which two organisms share nutrients are prevalent across the tree of life. Former PhD student Dr Inga Elizabeth CONTI-JERPE of the School of Biological Sciences from the class of 2019 proposed to apply a new technique she developed during her PhD that uses stable isotope analysis to quantify nutrient sharing in symbioses. She will use this method to measure nutrient exchange in a diversity of marine invertebrates, plants, and lichens to determine if certain traits are adaptations for more or less sharing. She was awarded a prestigious Plant Genome Postdoctoral Research Fellowship from the National Science Foundation of US. The proposed research will investigate the traits and underpinning genetics that modulate nutrient exchange between symbiotic partners at the University of California, Berkeley.

'I'm excited to use both stable isotope analysis and advanced genetic techniques to understand symbioses," says Dr Conti-Jerpe. "Combining these technologies has huge potential, and I'm thrilled by the opportunity to add molecular tools to my toolkit.'

Full story: https://bit.ly/30yJ2BV

Acknowledgements

We would like to express gratitude to our donors for their recent support, which is paramount for us to grow and scale new heights (in alphabetical order).

Individual donors
Ms Winnie Oi Yee CHAN
Mr Wing Wah CHAN
Professor Chi Ming CHE
Ms Sabrina PANG
Professor David Lee PHILLIPS

Corporate donors
The Croucher Foundation Ltd.
Guangdong Aglaia Optoelectronic Materials Co., Ltd.
Institute of Geology and Geophysics, Chinese Academy of Sciences
Ocean Park Conservation Foundation, HK
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Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai)
Yunnan University