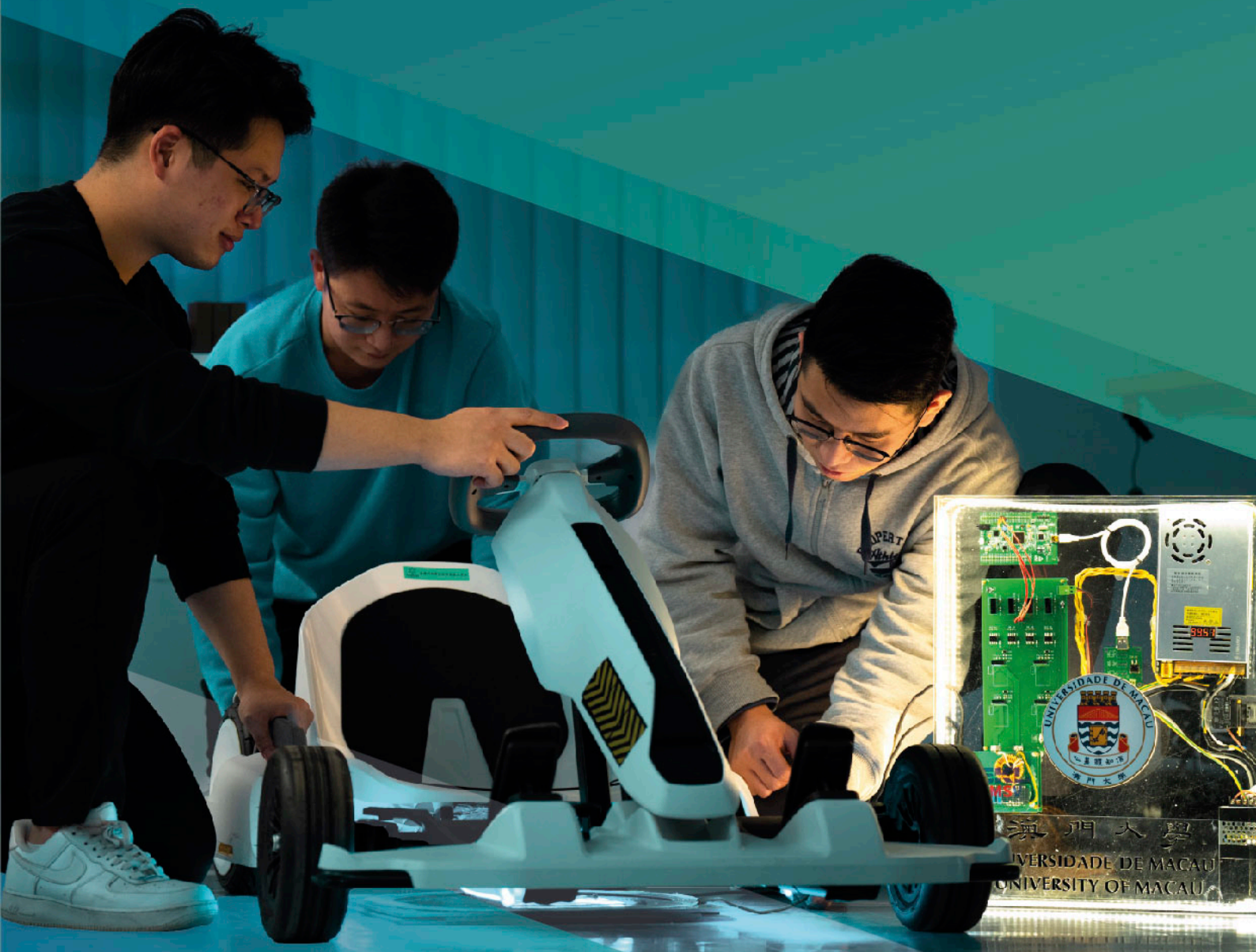
Spring/Summer 2022 | Issue 25

澳大新語 UMagazine



研究成果
從實驗室走進生產線

Research Results Transfer from the Laboratory to the Production Line

Spring/Summer 2022 | Issue 25

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2022年|總第25期

出版: 澳門大學 **Publisher:** University of Macau

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製版印刷: 澳門豪邁實業有限公司 **Printing:** Hamah (Macau), Limitada

國際刊號: 2077-2491 **ISSN:** 2077-2491

《**澳大新語**》創於2009年，為澳門大學官方刊物之一，每年出版兩期，旨在展示澳門大學的創見和突破、報導教研和社會服務的最新發展和成果。

Published biannually since 2009, ***UMagazine*** is one of the University of Macau's official publications and aims to report innovative ideas and research breakthroughs of the University of Macau. It also showcases the latest developments and achievements of the university in teaching, research, and service.

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編者的話

EDITOR'S WORDS

為助力澳門經濟適度多元發展，在國家政策支持和澳門特區政府推動下，澳門大學的產學研項目蓄勢待發，在澳門、橫琴粵澳深度合作區和粵港澳大灣區其它地方轉化科研成果，促進經濟和產業發展。

今期《澳大新語》封面專題探討澳大新的「五位一體」研究創新及轉化體系。該體系是《澳大五年發展規劃（2021/2022-2025/2026學年）》的重點規劃之一。我們採訪了宋永華校長、葛偉副校長和多位教授，一同探討「五位一體」體系如何協助研究人員將其成果從實驗室帶到生產線。

「三文四語」是澳門獨特的語言景觀。澳大匯聚了一批來自世界各地的語言學家。他們在大學多語多文化的環境傳道授業，使澳大的語言教學形成鮮明特色，今期專題我們探討其獨特之處。

我們也訪問了經濟學系主任朱智豪教授和卓越教學獎得主、英文系助理教授盧杰，分享他們的教研經驗。「學術研究」剖析新型冠狀病毒Delta突變株的傳染性，以及運用人工智能從中藥篩選潛在老人癡呆藥物的最新研究。

澳大設有10所書院，各具特色，在澳門獨一無二。書院作為多元文化與多元學科融會貫通的知識整合學習平台，體現了大學本科教育融合專業、通識、研習及社群教育的「四位一體」全人教育模式。今期新推出「書院發展」，帶領讀者了解鄭裕彤書院的學生創業模式，以及滿珍紀念書院跨學科和具國際化色彩的教育。

張惠琴 Katrina Cheong

With the support of the national policy and the Macao Special Administrative Region (SAR) government, the University of Macau (UM) has launched a number of projects involving industry-academia collaboration in order to promote moderate economic diversification of Macao. Some of the projects are currently undergoing a process of technology transfer in Macao, the Guangdong-Macao In-Depth Cooperation Zone in Hengqin and other parts of the Guangdong-Hong Kong-Macao Greater Bay Area, and are expected to generate economic value and promote the development of various industries.

The cover story of this issue's *UMagazine* features UM's new '5-in-1' system for research innovation and results transfer. The system is one of the key initiatives set out in the university's Five-Year Development Plan (Academic Years 2021/2022 to 2025/2026). We interviewed Rector Yonghua Song, Vice Rector Ge Wei, and some other professors about how the system can help UM researchers bring their research results from the laboratory to the production line.

Macao is a unique and linguistically diverse community, with three primary written languages and four primary spoken languages. Taking advantage of this multilingual and multicultural environment, UM has gathered linguists from around the world who developed a model of language education with distinctive characteristics on the campus. In this issue, we talk to these scholars to gain a deeper understanding of language teaching at UM.

We also interviewed Prof Angus Chu, head of the Department of Economics, and Prof Jeremy De Chavez, assistant professor in the Department of English and recent recipient of the UM Teaching Excellence Award. These two professors shared with us their experience in teaching and research. The Academic Research column explores two of the latest research topics at UM, namely the contagiousness of the SARS-CoV-2 Delta strain and the role of artificial intelligence in identifying compounds from traditional Chinese medicine with therapeutic potential against Alzheimer's disease.

UM is the only university in Macao with a residential college (RC) system, which is a multicultural and multidisciplinary learning platform for knowledge integration. Consisted of ten unique RCs, the RC system embodies the concept of whole-person education at the undergraduate level through a '4-in-1' model that includes discipline-specific education, general education, research and internship education, and community and peer education. To help readers learn more about each RC, we have launched a new section titled RC Development. In this issue, the section covers an entrepreneurship model that Cheng Yu Tung College has developed to help students start businesses, and explores the characteristics of Moon Chun Memorial College that make it a multidisciplinary and international institution.

目錄

CONTENTS

2022年|總第25期
Spring/Summer 2022 | Issue 25

橫琴粵澳深度合作區為澳大帶來新發展機遇（小圖為設於橫琴的珠海澳大科技研究院）

The Guangdong-Macao In-Depth Cooperation Zone in Hengqin has brought new opportunities for development for UM (The photo on the upper right is the Zhuhai UM Science & Technology Research Institute in Hengqin)

澳大與企業合作轉化研究成果

UM Collaborates with Enterprises to Promote Research Results Transfer

文 / 葉浩男．圖 / 編輯部．英文翻譯 / 蘇恩霆

Chinese / Davis Ip．Photo / Editorial Board．English Translation / Anthony Sou

澳門大學近年成為許多本地和內地企業推動創新的重要合作夥伴。他們攜手在澳門和橫琴促進大健康、現代金融、高新技術、會展商貿和文化體育共四大新產業發展，同時推動澳大研究成果從實驗室走進生產線、轉化具條件的研究成果。

科研成果與企業需求配對

澳大校長宋永華教授表示：「大學科研成果最終要走向市場，為經濟和社會發展服務。如果創造知識是從無到有的第一步，為新知識開發應用技術就是第二步，接下來則是將技術轉化為產品和服務。學術和研究機構可以單獨走前兩步，接下來必須有業界參與。」

國家《第十四個五年規劃和2035年遠景目標綱要》、澳門特區《第二個五年規劃（2021-2025年）》和《橫琴粵澳深度合作區建設總體方案》均指出，澳門應加強與粵港澳大灣區其它地方的產學研協同發展。宋永華教授表示，澳大作為澳門一所國際化綜合性公立大學，其開展的產學研項目含括澳門第二個五年規劃提出的、需加強發展的四大產業（以中醫藥研發製造為切入點的大健康、現代金融、高新技術、會展商貿和文化體育），合作夥伴主要來自澳門、橫琴粵澳深度合作區和大灣區其它地方。

他又指：「為支持澳門經濟適度多元發展，澳大近年將科研成果與企業需求配對，一些科研項目早期已有企業參與，形成產學研深度協同發展。大學與企業合作也不局限於個別研究員與企業的單項合作，還有大學整體推動、明確面向澳門新產業所需的大型合作計劃。」

佈局灣區三年有成

宋永華教授指出，澳門市場狹小、產業用地有限、科技人才不足，澳大的產學研發展不能局限於本地。自2019年2月《粵港澳大灣區發展規劃綱要》公佈後，澳大採取了多項重要措施參與區內產學研發展，最重要的是同年3月依托珠海澳大科技研究院（以下簡稱珠研院）在大灣區設立首個產學研示範基地。

珠研院在先進材料、智慧城市、微電子、轉化醫學、中華醫藥共五個領域設研發中心，亦設人文社科研究中心和高級培訓中心。在過去三年，該院與澳門和內地數十間企業合作，獲多項國家級、省級和市級機構提供科研資金開展項目。珠研院承接包括國家自然科學基金、科技部重點研發計劃等政府科研項目。該院2020年起先後獲批成立及認定為「博士後科研工作站分站」、「珠海市新型研發機構」及「廣東省新型研發機構」。

澳大也在珠研院設立了校內三個國家重點實驗室橫琴分部，將大學在中醫藥、微電子和智慧城市物聯網等方面積累多年的成果產業化。此外，澳大積極支持師生在橫琴設立科技企業，經澳大創科有限公司將澳大專利轉讓予企業，以及與企業建立聯合實驗室。

宋永華教授表示，2021年9月公佈的《橫琴粵澳深度合作區建設總體方案》提出大力發展集成電路、電子元器件、新材料、新能源、大數據、人工智能、物聯網、生物醫藥產業，澳大在這些領域均有一定成果和培養出一批人才。他說：「借助大學三個國家重點實驗室、優勢學科和院所之力，我們積極與澳門和大灣區其它地方的企業及政府部門合作，逐步構建出一條從原創科技、關鍵技術突破到融入大灣區產業鏈的生態鏈。」

集力建設成果產業化路徑

為配合中央和澳門特區政府關於產學研發展的重大規劃，校方在《澳門大學五年發展規劃（2021/2022-2025/2026學年）》（以下簡稱《五年發展規劃》）中重點提出構建「五位一體」研究創新及轉化體系，充分發揮三個國家重點實驗室的引領作用，從創新、服務、管理、培育、實踐五個維度構建高水平產學研平台，集中力量建設出一條澳大科研成果產業化的路徑。宋永華教授表示，這五個產學研平台環環相扣，將會形成合力，全面提升澳大產學研發展的深度和廣度。

澳大校長宋永華教授表示，大學將在產學研方面創出更多成果。
Prof Yonghua Song, rector of UM, says the university seeks more achievements in industry-academia collaboration.

在推進科研成果轉化發展方面，澳大採取多項措施，包括獲批設立教育部精準腫瘤學前沿科學中心、積極建設橫琴產學研示範基地、成立澳門中藥研發中心和澳門轉化醫學創新研究院、與中國科學院建立的五個聯合實驗室確立多項合作專項課題，以及參與和承擔更多澳門、廣東省和國家層面的重點研發項目，並繼續參股由澳大教員或研究團隊成立的初創公司。另外，獲批為國家級眾創空間的澳大創新創業中心已孵化30多家由師生共建的科技企業，正積極推動和鼓勵更多澳門青年面向大灣區開展創新創業活動。

為澳門和橫琴新產業培養緊缺人才

從師資力量、教學水準和科研實力而言，澳大在大灣區尤其是西岸優勢突出。大學近年開辦了微電子、數據科學和金融科技等方面的新課程，也準備增設藥物科學及科技學士課程，以及全球公共衛生、物聯網、機器人與無人系統、近岸及環境工程、認知與腦科學、先進新材料和藝術學等領域的研究生課程，全面培養澳門和橫琴新產業緊缺的人才。

在中央和澳門特區政府大力支持下，澳大各方面發展一日千里。宋永華教授表示，澳大是目前唯一設於橫琴島的大學，有責任培養更多人才，在產學研方面創出更多成果。「大學既是政策受益者，也應是能推動社會和經濟發展的貢獻者。澳大研究一直貫徹『國家所需、澳門所長，澳門所需、澳大所長』的方針，通過不斷拓展及加深與內地合作，更好地發揮澳門與內地的優勢，實現協同創新、協同發展，使澳門融入國家創新科技發展大局。目前澳門經濟結構急需轉型，澳大將繼續配合中央和特區政府的政策部署，加快推動科研成果從實驗室走進生產線，服務國家和澳門所需。」

In recent years, the University of Macau (UM) has become an important partner for many local and mainland enterprises to promote innovation. UM has worked together with its partners to foster the development of four new industries in Macao and Hengqin: health, modern finance, high technology, as well as exhibitions and trade/culture and sports. The collaborations also facilitate the transfer of research results from the laboratory to the production line, enabling the translation of research results.

Matching Research Results with the Right Enterprises

According to UM Rector Yonghua Song, technological research results of universities should ultimately be commercialised to serve economic and social development. 'If creating knowledge is the first step in starting something from scratch, developing applied technologies for the new knowledge is the second step, followed by transforming the technologies into products and services,' says Prof Song. 'Academic and research institutions can take the first two steps on their own, but the next step must involve industry.'

China's 14th Five-Year Plan and Vision 2035 plan, the second Five-Year Plan (2021-2025) of the Macao Special Administrative Region (SAR), and the Master Plan of the Development of the Guangdong-Macao In-Depth Cooperation Zone in Hengqin all point out that Macao should strengthen collaboration with other locales in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) for the development of the industrial, academic, and research sectors. According to Prof Song, as an international public comprehensive university in Macao, UM has launched collaboration projects with enterprises in the four aforementioned industries, which are also highlighted in the second five-year development plan of Macao as 'a health industry with Chinese medicine R&D and manufacturing as an entry point, a modern finance industry, a high technology industry, as well as an industry of exhibitions and trade/culture and sports'. The university's collaboration partners are mainly located in Macao, the Hengqin cooperation zone, and other parts of the GBA.

'To support the moderate economic diversification of Macao, UM has been matching its existing research achievements with the demand of enterprises in various industries. The university has also launched research projects that involve enterprises in the early stages. This strategy has created a deep synergy between the industry, academic, and research sectors,' says Prof Song. 'The collaborations between the university and enterprises are not limited to individual researcher-enterprise collaborations, but also

澳大開辦新課程為澳門和橫琴新產業培養緊缺人才

UM offers new programmes to nurture talent for new industries in Macao and Hengqin

include large-scale collaborative projects at the university level that are clearly geared towards the needs of Macao's new industries.'

Three Years of Contributions to the GBA

According to Prof Song, Macao's market is small, with limited industrial land and a shortage of technology professionals, so industry-academia collaboration at UM cannot be confined to the local area. Since the announcement of the Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area in February 2019, UM has taken a number of important initiatives to participate in industry-academia collaboration in the region. The most important was the establishment of UM's first demonstration base for industry-academia collaboration in the GBA via the Zhuhai UM Science & Technology Research Institute (ZUMRI) in March of the same year.

ZUMRI has five R&D centres in the areas of advanced materials, smart city, microelectronics, translational medicine and Chinese medicine. It also includes a humanities and social sciences research centre and an executive training centre. Over the past three years, the institute has collaborated with dozens of enterprises in Macao and mainland China and has received research funding from national, provincial, and municipal institutions, including funds from the National Natural Science Foundation of China and the National Key R&D Programme. Since 2020, ZUMRI has been named a postdoctoral research station, a new R&D institute in Zhuhai, and a new R&D institute in Guangdong.

UM has set up branches of its three state key laboratories within the institute to promote the commercialisation of the university's achievements in Chinese medicine, microelectronics, and the internet of things for smart cities. In addition, UM actively supports students and faculty in setting up technology enterprises in Hengqin, transferring the university's patents to enterprises through UMTec Limited, and establishing joint laboratories with enterprises.

According to Prof Song, the Master Plan of the Development of the Guangdong-Macao In-Depth Cooperation Zone in Hengqin released in September 2021 proposes to vigorously develop industries focused on integrated circuits, electronic components, new materials, new energy, big data, artificial intelligence, internet of things, and biomedical sciences, all of which are areas where UM has already made achievements and nurtured a considerable number of professionals. 'Taking advantage of the research strengths of the university's three state key labs and institutes in key disciplines, we are actively collaborating with enterprises and government departments in Macao and other parts of the GBA,' says Prof Song. 'We have created an ecosystem that is capable of developing original technology, achieving technological breakthroughs, and integrating new research results into industries in the region.'

Paving the Way for the Commercialisation of Research Results

In line with the major plans of the central government and the Macao SAR government on industry-academia collaboration, UM has proposed in its Five-Year Development Plan (Academic Years 2021/2022-2025/2026) to develop a '5-in-1' system for research results transfer. UM will expand its three state key labs and build five high-level platforms for industry-academia collaboration, incorporating innovation, service, management, cultivation, and implementation respectively, to promote technological innovation and transfer of research results. According to Prof Song, the five platforms are interlinked and will form a synergy to enhance the depth and breadth of industry-academia collaboration at UM.

In terms of the transfer of research results, the university has taken a series of measures, including establishing the Frontier Science Center for Precision Oncology as approved by the Ministry of Education, a demonstration base for industry-academia collaboration in Hengqin, an R&D centre for Chinese medicine, and the Macau Institute for Translational Medicine and Innovation. UM also launched a series of collaborative projects in five joint labs with the Chinese Academy of Sciences, participated in and undertook key R&D projects at the local, provincial, and national levels, and continues to invest in start-up companies established by UM faculty members or research teams. In addition, UM's Centre for Innovation and Entrepreneurship, which has received approval to serve as a national co-working space, has incubated more than 30 science and innovation enterprises jointly established by students and professors. It is actively encouraging more Macao youth to launch innovation and entrepreneurship activities in the GBA.

Nurturing Talent for New Industries in Macao and Hengqin

Across the GBA, especially in the western part of the region, UM has distinct advantages over its counterparts in terms of faculty, quality of teaching, and research capacity. In recent years, the university has launched new programmes in areas such as microelectronics, data science, and financial technology. It is preparing to offer a new undergraduate programme in pharmaceutical sciences and technology, as well as postgraduate programmes in various fields, such as global public health, internet of things, robotics and unmanned systems, coastal and environmental engineering, cognitive neurosciences, advanced materials, and fine arts, in order to develop a comprehensive array of talent to respond to the demand of new industries in Macao and Hengqin.

With the tremendous support of the central government and the Macao SAR government, the university has rapidly developed in all aspects. According to Prof Song, as the only university on Hengqin Island, UM has the responsibility for nurturing professionals and producing results via industry-academia collaboration. 'The university is not only a beneficiary of government policies, but also a contributor to social and economic development,' says Prof Song.

'Through research, UM aims to leverage the advantages of Macao and the university to respond to the needs of China and the city, respectively. By continuously expanding and deepening our collaboration with stakeholders in mainland China, we can give full play to the strengths of Macao and the mainland to achieve collaborative innovation and development, and to integrate Macao into the overall development of innovation and technology in the country. At a time when Macao's economic structure is in dire need of transformation, UM will continue to complement the policies of the central government and the SAR government to accelerate technology transfer in order to serve the needs of the country and Macao,' he adds.

澳大為促進產學研發展提供各種支援。圖為澳大科研基地。
UM takes various steps to support industry-academia collaboration. This picture shows the scientific research base at UM.

產學研平台促進成果轉化

Accelerating Research Results Transfer through Various Platforms for Industry-Academia Collaboration

文 / 葉浩男、校園記者林程峰．圖 / 編輯部
Chinese & English / Davis Ip, UM Reporter Victor Lam．Photo / Editorial Board

為推動澳門產業多元化發展，澳門大學積極部署新的研究戰略，同時建立並完善「五位一體」研究創新及轉化體系，從創新、服務、管理、培育和實踐等維度構建高水平產學研平台，提升科研成果質量和影響力，系統推動科技創新和成果轉化。

研究戰略佈局

澳大副校長（研究）葛偉教授表示，澳門特區政府注重產學研發展，社會也期盼澳門產學研發展有更大進展，因此澳大作出新的研究部署，尤其是推動研究創新及成果轉化。

推動產學研發展，首重研究創新。澳大的「3+3+3+3」研究戰略佈局包括中醫藥、微電子和智慧城市物聯網三個國家重點實驗室。該佈局也包括三個重點發展方向，分別是癌症醫學（主要由健康科學學院負責）、先進材料（主要由應用物理及材料工程研究院負責）和區域海洋（主要由區域海洋研究中心負責）。

在該佈局下，大學充分利用協同創新研究院的跨學科平台，支持三個跨學科領域發展。該院設三個研究中心，分別是認知與腦科學研究中心、人工智能與機器人研究中心、數據科學研究中心。三者均跨越人文社科和科技兩大領域，備有先進儀器和設備，很多使用者是人文社科教授。

此外，澳大人文社科領域的研究力量也十分強大，在有關領域有三個校級研究平台，包括近年成立的人文社科高等研究院，以及亞太經濟與管理研究所和澳門研究中心。上述所有元素共同構成大學的研究創新體系，也是「五位一體」產學研體系中最重要的一環。

轉化體系引發協同效應

「五位一體」科研成果轉化體系是《澳門大學五年發展規劃（2021/2022 - 2025/2026學年）》的重要部分，重心是建立和完善創新、服務、管理、培育及實踐共五類平台。葛教授說：「五類平台均有重要角色，但此體系最大特點在於平台互通。當不同平台整合為一體，就能產生協同效應。」

「五位一體」成果轉化體系第二類平台是服務平台，主要由澳大研究服務及知識轉移辦公室向大學師生提供研究服務，以及負責知識產權的管理、申請和轉化。葛教授指出，知識產權、專利和成果出現後便需要管理平台，即「五位一體」成果轉化體系第三類平台。這一環主要由澳大全資擁有的澳大創科有限公司負責。澳大創科主要任務是管理、推廣和應用知識產權，包括澳大在海外和內地持有的100多個專利及其商業轉化。葛教授說：「如有公司對某項技術感興趣，他們不會和大學談判，而是找澳大創科。澳大創科在我們整個產學研發展體系扮演核心角色，因為知識產權轉化的最後階段均通過澳大創科完成。」

創新創業孵化平台

考慮到大部分教授和學生商業經驗不足，大學的「五位一體」成果轉化體系專門設有孵化平台，作為其第四類平台。澳大在協同創新研究院之下成立創新創業中心，為有意創業的師生提供各種支持、培訓和服務。在2019年澳門回歸20週年之際，該中心獲國家科學技術部批准成為國家級眾創空間。

自成立以來，創新創業中心已孵化30多個師生創業團隊。這些團隊離開中心時會正式註冊公司，繼續發展，為澳門產業多元化作貢獻。葛教授指出：「澳大創科目前持有多間經大學孵化的初創公司的股份，在促進知識產權轉化方面發揮了重要作用。」

產學研實踐平台

「五位一體」成果轉化體系最後一環是實踐平台。很多團隊在創新創業中心接受培育後會通過澳大創科聯繫企業。有一些團隊則已有較成熟和接近市場的產品或技術，可以直接和企業對接。

澳大師生有很多研究項目，基本上處於初期階段，但繼續研究下去可能會有商業價值。在這種情況下，澳大會推薦一些項目到珠海澳大科技研究院（以下簡稱珠研院）進一步發展。珠研院地處橫琴，可取得不少內地資源，也能支持團隊參與內地較完整的產業鏈。珠研院也因此構成了澳大產學研的實踐平台。珠研院正推進及已完成的項目有160多個，包括110多個國家級、省級和市級項目，以及50多個與企業的合作項目。

葛教授說：「創新、服務、管理、培育和實踐平台，加起來就是澳大較完整的產學研生態體系。有時研究人員會說，我研究到這個階段，下一步可以怎樣？我們有了這個體系，就能清楚下一步該如何走。」

與50多間企業合作

澳大研究成果轉化集中在材料、生物醫學（包括中醫藥）、微電子、智慧城市物聯網、人工智能，大數據和人文學科（如語言翻譯系統）等領域。澳大目前與50多間企業合作，除了內地公司，也非常積極與本地公司合作，包括澳門電力股份有限公司、澳門電訊有限公司和南光集團。2021年，澳大還與澳門博維資

澳大副校長（研究）葛偉教授
UM Vice Rector (Research) Ge Wei

訊系統有限公司簽署戰略合作框架協議，建設聯合實驗室，目前也積極推動與源自澳門的芯片領域獨角獸企業芯耀輝科技共建聯合實驗室。葛教授說：「澳大在澳門與公共和私營企業都有相當多合作，在澳門科技和產業的創新作用毋庸置疑。」

天時地利人和

澳大是澳門一所綜合性公立大學，在協助政府促進科技商業化方面責無旁貸。當下，澳大推動科技創新和成果轉化可謂是天時地利人和俱備。葛教授說：「天時，就是粵港澳大灣區協同發展，為澳大創造千載難逢的機會。橫琴粵澳深度合作區在2021年成立，也為澳大帶來新動能。地利，則是澳門是灣區核心城市，澳大又坐落於橫琴。人和，是澳門特區政府重視產學研發展，社會各界都清楚經濟多元化是澳門的必然方向，全力以赴推動產學研發展。」

經過41年發展，澳大研究成果豐碩。大學在此環境下加快產學研發展，積極利用過去打下的基礎，前景廣闊無比。葛教授說：「澳大一些中藥產品已非常接近市場。在先進材料、中醫藥、微電子等方面，澳大技術已經深植於很多公司的產品。」

研究成果在轉化過程中，除了大學，還需要政府和企業的充分參與。葛教授說：「企業會給我們帶來很多研究的啟發，他們的意見更可以幫助師生設計的產品或開發的技術進一步接近市場所需。」

灣區機遇助科研成果轉化

在研究創新及轉化體系下，澳大各領域的研究人員和單位齊心協力，長遠必將提升大學的科研創新能力和產學研合作成效。葛教授指出：「澳大將會更充分地結合國家和內地省市的科研資源，與更多海內外一流大學及優秀企業開展高水平科研創新和產學研合作。」

大灣區正積極構建國際科技創新中心，無疑為大學和研究人員創造更廣闊的空間，將研究成果付諸實現。在此背景下，澳大的研究創新及轉化體系不單體現了其在推動科研成果轉化的願景和具體行動，更展現大學以科研造福社會的決心。

The University of Macau (UM) has developed a new and ambitious research strategy. UM has also been building and improving a new ‘5-in-1’ system for research innovation and results transfer. The new system, which aims to support the economic diversification of Macao, includes high-level platforms for various stages of industry-academia collaboration, including innovation, service, management, cultivation, and implementation. It will enable the university to enhance the quality and impact of its research results, to further promote research and innovation, and to support the systematic transfer of research results.

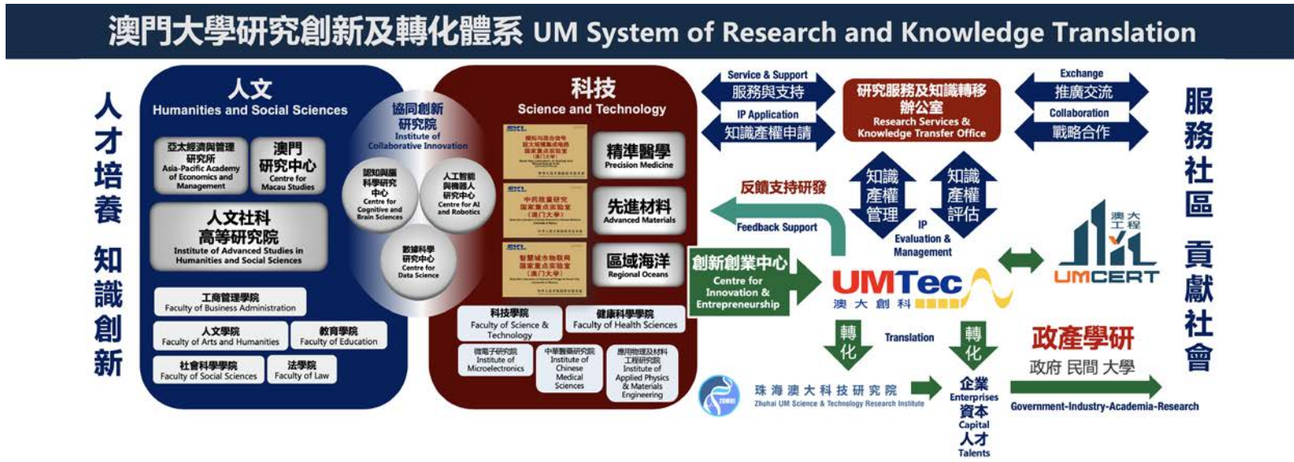
澳大工程研究及檢測中心有限公司為社會提供專業服務

UMCERT Engineering Research and Testing Limited provide professional services for society

Strategic Research Layout

According to Prof Ge Wei, UM vice rector for research, the Macao Special Administrative Region (SAR) government attaches great importance to industry-academia collaboration and many people in the community expect further progress in this realm. As a response, UM has identified several areas to give priority to research, innovation, and the transfer of research results.

Research and innovation are among the most important aspects of industry-academia collaboration. To this end, UM has developed a ‘3+3+3+3’ strategic research layout. The first ‘3’ refers to the three state key laboratories for Chinese medical sciences, microelectronics, and the internet of things for smart cities, respectively. The second ‘3’ refers to three emerging research



澳大研究創新及轉化體系

The system for research innovation and results transfer at UM

areas, namely precision medicine (mainly through the Faculty of Health Sciences), advanced materials (mainly through the Institute of Applied Physics and Materials Engineering), and regional oceanology (mainly through the Centre for Regional Oceans).

The third ‘3’ refers to the three interdisciplinary research areas supported by three centres under the Institute of Collaborative Innovation (ICI), namely the Centre for Cognitive and Brain Sciences, the Centre for Data Science, and the Centre for Artificial Intelligence and Robotics. The three centres all span the fields of humanities and social sciences as well as science and technology, and are all equipped with advanced facilities and equipment, with many of the users being professors of humanities and social sciences.

The fourth ‘3’ refers to the three university-level research platforms of UM in the humanities and social sciences, areas where the university has a strong research culture. They include the recently-established Institute for Advanced Studies in Humanities and Social Sciences, the Asia-Pacific Academy of Economics and Management, and the Centre for Macau Studies. All of the elements above combine to form a mechanism for research and innovation at UM, which is also the first and most important type of platform in the ‘5-in-1’ system.

A Transfer System that Creates Synergy

The ‘5-in-1’ system for research innovation and results transfer is an important part of the university’s Five-Year Development Plan (Academic Year 2021/2022-2025/2026). This system aims to build and enhance platforms for the five phases of industry-academia collaboration, namely innovation, service, management, cultivation, and implementation. ‘While each of the five categories of platforms has an individual role to play, the system allows them to interact with each other,’ says Prof Ge. ‘When different platforms are integrated into one, synergies can be created.’

Service platforms constitute the second type of platform in the ‘5-in-1’ system. Most are operated by the Research Services and Knowledge Transfer Office. The office provides research services to staff and students, and handles the management and transfer of intellectual property rights (IPRs) of UM, as well as their applications. According to Prof Ge, the available IPRs, patents, and research results call for management platforms, which are the third type of platform in the ‘5-in-1’ system. UMTec Limited, a wholly-owned subsidiary of UM, is primarily responsible for managing these IPRs. The university entrusts UMTec Limited to manage, promote and apply all its IPRs, including more than 100 patents filed in mainland China and overseas, and their commercialisation. ‘If a company wants to use a technology from UM, it can turn to UMTec rather than the university,’ says Prof Ge. ‘UMTec plays a central role in our industry-academia

collaboration system. The company takes care of the final phase of transferring our IPRs.'

Cultivation Platform for Innovation and Entrepreneurship

Most professors and students lack commercial experience. That is why UM has included cultivation platforms in the '5-in-1' system as the fourth type of platform. The Centre for Innovation and Entrepreneurship (CIE) under the ICI provides various types of support, training, and services to students and professors who want to start a business. In 2019, which marked the 20th anniversary of the handover of Macao, the CIE received approval from the Ministry of Science and Technology to join China's national system of co-working spaces.

Around 30 business teams, founded by UM students and faculty members, have been incubated in the CIE. When incubation is completed, the teams continue to exist as registered companies to contribute to the industrial diversification of Macao. 'With shares in many start-up companies incubated at UM, UMTec is playing an important role in the transfer of the university's IPRs,' says Prof Ge.

Implementation Platform for Industry-Academia Collaboration

The fifth and last type of platform under the '5-in-1' system is the implementation platform. Many teams incubated at the CIE have been connected by UMTec to companies for cooperation. Meanwhile, teams with products or technologies that are more mature and closer to market needs can approach potential partners directly.

Many products developed by UM research teams are still in their initial stages, but they show great promise for applications. In this context, the university would recommend they seek further development at the Zhuhai UM Science & Technology Research Institute (ZUMRI). As the university's demonstration base for industry-academia collaboration in Hengqin, the institute has access to rich research resources in mainland China. In essence, ZUMRI is serving as UM's implementation platform for industry-academia collaboration.As of today, the institute has about 160 ongoing or completed projects. They include over 110 projects funded by national, provincial, and municipal agencies and over 50 collaborative projects with enterprises. 'The innovation, service, management, cultivation, and implementation platforms together form a fairly complete ecosystem for industry-academia collaboration. Sometimes researchers wonder what the next step will be for their research projects. With this system in place, we can show them exactly what the next step is.' says Prof Ge.

Partnerships with Over 50 Companies

UM has transferred its research results in several key areas, including materials, biomedical sciences (including traditional Chinese medicine), the Internet of Things for smart city development, artificial intelligence, big data, and humanities (such as translation systems). UM actively collaborates with over 50 commercial partners, which are based in the mainland and Macao. The university's local partners include Macao's electricity company CEM, telecommunications provider CTM, and Nam Kwong (Group) Company Limited. In addition, UM signed a strategic collaboration framework agreement with Boardware Information System Limited in 2021 on the establishment of a joint laboratory. The university is also actively planning a joint laboratory with Akrostar Technology, a Macao-based chip unicorn company. 'UM has extensive collaborations with public and private enterprises across Macao. One can easily see the university's role in promoting technological and industrial innovation in this city.'

Right People, Right Time, and Right Place

UM has a vital role to play in helping the government promote technological innovation and transfer research results. According to Prof Ge, UM has encountered the right people in the right place at the right time, which will help the university fulfil its responsibility as a comprehensive public university. 'The timing is right as UM is able to grasp the unprecedented opportunities brought about by the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) for collaborative development. The Guangdong-Macao In-Depth Cooperation Zone in Hengqin established in 2021 has also given the university new impetus. We are in the right place because Macao is a core city of the GBA, and our university is located on Hengqin island,' says Prof Ge. 'The Macao SAR government attaches great importance to industry-academia collaboration. It has become clear to people from all sectors that economic diversification is essential for Macao's future development. Industry-academia collaboration has therefore become a shared goal for all members of the community,' says Prof Ge.

澳大一些中藥研究成品已非常接近市場
UM will soon launch some traditional Chinese medicine-based products

41 years after its founding, UM has become a university with many outstanding results. Now is the time that the university should accelerate industry-academia collaboration and take stock of past achievements to advance development. 'Some of our university's products in traditional Chinese medicine are about to be launched,' says Prof Ge. 'Many companies in the fields such as materials, traditional Chinese medicine, and microelectronics have already integrated technologies from UM into their products.'

In the process of research results transfer, the government and enterprises need to be fully involved, apart from initiatives from universities. Prof Ge says: 'Companies give us a lot of ideas for research, and their input can help students and professors produce products or technologies that are closer to the needs of the market.'

Taking Advantage of GBA Opportunities to Transfer Research Results

The new system for research innovation and results transfer will bring UM researchers and units in all areas to work together. In the long run, the collaborative effort will improve the university's research and innovation capacity and make industry-academia collaboration more effective. 'The university will make better use of research resources provided by the central government as well as different provinces and cities. We will also launch more projects in research innovation and industry-academia collaboration with top universities and enterprises at home and abroad,' says Prof Ge.

At the moment, the GBA is transforming itself into an international centre for innovation and technology, which will open up more opportunities for universities and researchers to transfer their research results. Against this backdrop, the new system for research innovation and result transfer at UM demonstrates not only the university's vision and concrete actions to promote technology transfer, but also its determination to change society for the better through research.

掃二維碼
觀看訪談片段
Scan the QR code to watch the interview

澳大的芯片技術於橫琴・澳門青年創業谷進行成果轉化

Chip technologies developed at UM are being commercialised in the Hengqin-Macao Youth Entrepreneurship Valley

高新技術產品投入市場應用

Placing Products of High Technology on the Market

文 / 余偉業・圖 / 何杰平、部分由受訪者提供・英文翻譯 / 蘇恩霆

Chinese / Kelvin U・Photo / Jack Ho, with some provided by the interviewees・English Translation / Anthony Sou

澳門大學積累多年科研成果，厚積薄發，例如在環境工程、中醫藥、先進材料、芯片、智慧城市物聯網等領域有多項具市場前景的創新技術，配合天時地利人和，正逐步透過澳大的研究創新及轉化體系，轉化成高新技術產品投入市場，從實驗室走進生產線，實現大學以研究造福社會的使命。

提取污泥變高價值商品

澳大團隊開發的市政污泥中高附加值資源回收系統在澳門科學技術發展基金主辦、國家科學技術部支持的「2021年科技周暨創科成果展」首次亮相。系統以污水廠二沉池剩餘的污泥為原料，提取和純化出工業級硫酸多糖，分離出工業級海藻酸鈉、卡拉膠、海藻酸鉀等產品，已獲兩項中國發明專利，正透過澳大的研究服務及知識轉移辦公室與多家環境工程及創業投資公司商討合作。

該系統技術成熟度達TRL6級別，從污泥提取的硫酸多糖經協力廠商檢測，品質滿足國家工業級硫酸多糖品質標準，純度與市售海藻產品相同。全球對工業級硫酸多糖的需求快速增長，其市場在2021年達154.3億美元。但傳統醫學級硫酸多糖生產複雜費時，全球嚴重供不應求。該研究項目負責人、區域海洋研究中心和土木及環境工程系助理教授郝天偉說：「我們的系統可廣泛用於城市污水處理廠。若每日處理100噸污泥，每年就可生產1,300噸硫酸多糖。以工業級硫酸多糖目前的市價60%來定價，估計每年收益可逾人民幣1,040萬元。」

研究團隊依托澳大區域海洋研究中心，不斷改良污泥提取硫酸多糖的工藝條件，以開發達醫學級別的提煉技術。郝天偉教授指出，自1987年科學家發現硫酸多糖可抑制愛滋病病毒之後，人們陸續發掘更多硫酸多糖的潛藏功能，如治療血栓、免疫性炎症和腫瘤。「我們證實了從污泥提取的硫酸多糖均具有抗腫瘤和抗凝血的活性功能。」

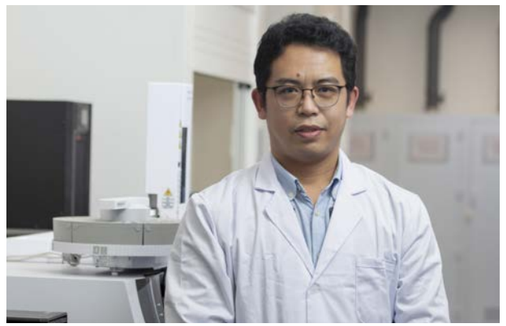
「城市每日處理生活污水和工業廢水時產生數以噸計污泥，與其焚燒它們，何不加以利用，把廢物變成高價值的產品？」郝天偉教授表示：「由於人們的刻板印象，污泥副產品仍待大眾接納，目前只有印度容許以從污泥提取的硫酸多糖作醫藥用途。有關研究仍需多作推廣，才能逆轉傳統思維。」

中醫藥創新產品

澳大研發基於中藥多糖的產品包括糖尿病足傷口敷料、促進骨組織再生的葡甘聚糖種植體塗層，以及不含酒精成份、抑菌的免洗護膚凝膠，正透過在澳大孵化、由澳大創科有限公司持股的金創克有限公司轉化研究成果，有的項目計劃臨床試驗，有的逐漸投入市場。研發團隊利用中藥質量研究國家重點實驗室（澳門大學）的研究平台，經過近10年艱苦研發後取得階段性成果，2017年註冊成立上述初創公司，同年入駐澳大創新創業中心，並獲得澳大創科有限公司的首批種子輪投資。

從實驗室樣品到商品，工藝和品質控制至為關鍵。該研究項目負責人、國家自然科學基金委員會優秀青年科學基金獲得者、國家中醫藥管理局「青年岐黃學者」、澳大中華醫藥研究院副教授王春明闡述三個產品的意義：「現時可用於糖尿病足的藥物不多，我們這款敷料的原料是從杜仲提取的天然成分，在小鼠實驗模型中能減輕患處供血困難的情況，如能用於人體，或可大大降低糖尿病患者的截肢風險。此外，很多人衰老時會有骨質疏鬆這個健康難題，目前有鈦釘等人工替代物替代骨質。我們研發的葡甘聚糖種植體塗層可促進鈦釘和骨頭整合，可望讓人們恢復缺損前的生活品質。最近，我們還因應抗疫所需設計了一款不含酒精、抑菌而又呵護肌膚的免洗凝膠，獲第三方研究所證明99%抑菌，而且用後皮膚不會乾燥。」

王教授團隊的這一系列研究項目獲澳門科技發展基金大力支持，是粵澳兩地中醫藥產業發展多年的一個代表性成果，也體現了澳門拓展以中醫藥研發製造為切入點的大健康產業。他們正把握橫琴粵澳深度合作區建設世界一流中醫藥生產基地和創新高地的機遇，依托珠海澳大科技研究院（以下簡稱珠研院）的產學研平台，並且借助澳門轉化醫學創新研究院整合資源，在糖尿病足傷口敷料、葡甘聚糖種植體塗層等項目進一步轉化成果。他們更與醫院合作開展臨床研究，期望技術早日落地，惠及大眾。他表示，團隊已就這三類研究項目採購了工業化設備，正準備建廠投產。「我們有信心，產品在市場推出後將有助減輕人口老化衍生的健康問題。」



郝天偉教授

Prof Hao Tianwei

市政污泥資源回收系統

A system to recover resources from sewage sludge produced by municipal sewage treatment plants

綠色建材工藝落地珠海

澳大的納米泡沫混凝土現澆回填配方工藝技術於2021年9月在河南完成試點工程，取得良好數據。這些技術在2022年3月於中國建築工程（澳門）有限公司在珠海高新技術產業開發區的工程項目應用，用來對主體工程地下結構四周與基坑混凝土灌注樁圍護之間的肥槽回填。該項目使用了5,000立方米泡沫混凝土。與市面工藝技術相比，澳大的納米泡沫混凝土現澆方案能節省約30%水泥，大幅降低原料成本和碳排放。

此高新技術正透過珠研院支持下成立的師生企業中山宜發建材科技有限公司投入市場。澳大另一項綠色建材「納米泡沫混凝土牆板」則已在江蘇南通、山西太原等地建立生產線。該研究項目負責人、應用物理及材料工程研究院副教授孫國星表示，納米泡沫混凝土的相關產品技術經已成熟，正進入市場開拓階段。「材料創新是產業發展創新的基礎，尤其是建築行業。在探索產業化時，我們發現材料創新與工藝創新一起，才能推動新材料量產和產業更新換代。」

《中國建築能耗研究報告（2020）》顯示，2018年中國的能源消耗有46.5%來自建築過程，其中水泥生產是碳排放的主要來源。孫國星教授團隊研發的納米泡沫混凝土是新型、輕質、高強的建築材料，不僅能大大減低水泥用量，更能提高建築物的恆溫能力，減低建築物在採暖製冷時因耗用能源而產生的碳排放。他說：「這種納米泡沫混凝土亦適用於屋面保溫、樓層墊高、空中泳池等空中建物、交通軌道，以及大型礦坑填充等泡沫混凝土現澆工程，可少用30%水泥，大幅降低原料成本，同時提升25%恆溫隔熱能力。」

孫教授說：「我們將按從中建（澳門）工程所得的數據，經珠研院的科研平台持續改良現澆工藝，並擴展下游應用的研究層面，從而推動技術成果的商業化乃至中國綠色建材行業的發展。」

在橫琴創業谷轉化芯片研究成果

澳大的芯片研究依托模擬與混合信號超大規模集成電路國家重點實驗室（澳門大學）頂尖的科研實力，不斷推進前沿研究，並透過澳大研究創新及轉化體系的強大後盾把芯片成果商業化，建設「澳門芯」科技品牌。

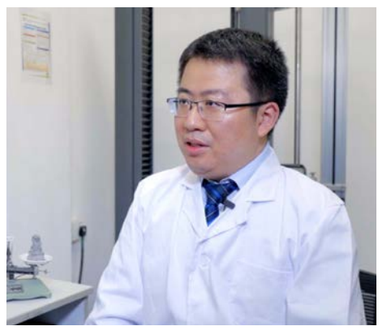
其中，VHunter核酸檢測儀是基於澳大先進的數字微流控芯片技術而開發，是有關師生多年共同努力的結晶。研究團隊把他們最初在實驗室的成果，發展成澳大創科有限公司的孵化項目。他們在2018年成立迪奇孚瑞生物科技有限公司，並獲澳大創科有限公司首批種子輪投資，其後在珠研院支持下到橫琴．澳門青年創業谷進一步把成果商品化，已在內地市場推出。

該研究項目負責人、模擬與混合信號超大規模集成電路國家重點實驗室（澳門大學）代主任、微電子研究院副院長麥沛然教授說：「澳大對VHunter項目市場化給予巨大支援，支持畢業生創業，把芯片技術專利授權給初創公司並入股其中，這是澳大首次入股畢業生團隊創立的公司。迪奇生物計劃發揮澳門及合作夥伴的優勢，將VHunter推至東南亞市場。」

VHunter可廣泛應用於傳染病防治領域，能簡單、快速、精準地檢測呼吸道病原體（如新型冠狀病毒、甲型流感病毒等）、子宮頸癌病原體、性傳染病原體、肺結核耐藥性等，並可連接電腦即時製作檢測報告。VHunter除了可以用來診斷疾病，還可用於健康指數檢測、動植物疾病檢測、食品安全檢測等，已獲珠海市疾病預防控制中心、拱北海關、斗門水產檢測中心等機構採購和使用。VHunter已獲醫療器械歐盟（CE）認證，正申請內地醫療器械註冊證。

納米泡沫混凝土技術應用於珠海高新技術產業開發區的實際工程

UM's construction technique using nano-foam concrete is applied in the Zhuhai National Hi-tech Industrial Development Zone



孫國星教授

Prof Sun Guoxing

麥沛然教授

Prof Mak Pui In

VHunter核酸檢測儀

VHunter, a nucleic acid detection kit

動態無線充電系統引業界關注

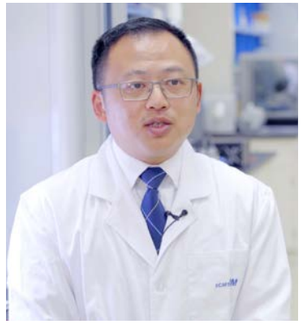
在研究服務及知識轉移辦公室穿針引線下，澳大的動態無線充電系統於2020年第七屆澳門工展會首次亮相，隨即引起業界關注。大學於2021年8月與澳門自來水有限公司簽署合作協議，將向在本地水塘的無人船提供無線充電，省卻替換電池和使用插拔式有線充電的人手。該技術亦可用於智能物流倉庫，透過在地面鋪設動態無線充電系統，為倉庫機器人24小時無間斷充電，減少人手，實現物流倉儲自動化。另一方面，在澳門特區政府積極推動電動摩托車之際，該技術可解決不同牌子充電器不一這個核心問題，也有助克服現時停車場換電池櫃成本高昂和存在安全隱患的難題。研究團隊已在澳門成立智澳科技有限公司，由澳大本地研究生組成，專門設計及開發無線充電系統及其他電力電子系統，希望將項目技術產業化並應用到澳門和大灣區其它地方多元化的場景，貢獻澳門經濟適度多元化發展。

內地目前約有32萬個倉庫，真正屬於智慧倉儲的不到兩萬個。該研究項目負責人、模擬與混合信號超大規模集成電路國家重點實驗室（澳門大學）、微電子研究院副教授林智聲表示，澳大的動態無線充電系統可以穩定地隔空傳輸電力，滿足智慧倉儲市場所需，市場潛力巨大。「我們的系統最大賣點是充電效率高，可達94%，優於市面各類無線充電產品，而且抗偏移能力強，即使與充電位置有20%偏移，仍可高效充電。」

澳門近年致力建設世界一流的智慧城市，透過基建設施的智慧轉型為居民提供更多高質素的服務，其中達成智慧交通的第一步是實現電動車輛全自動充電。林教授說：「我們可針對不同牌子或型號的電動車，設計動態無線充電的底盤，實現最高效的無線充電，當車輛駛過鋪有能量線圈的路面時便可馬上充電。」

智慧城市的建設離不開高效便民的能源配置。林智聲教授期望可在交通指示燈或斑馬線前的馬路底下加裝能量線圈，時刻為駛過的電動車輛無線充電，提升其續航能力。

The University of Macau (UM) has achieved many results in scientific research over the years in areas such as environmental engineering, traditional Chinese medicine, advanced materials, microelectronic chips, and the internet of things for smart cities. With the right people in the right place at the right time, the university is steadily transferring these innovative results with great commercial prospects from the laboratory to the production line in order to turn them into hi-tech products via its system for research innovation and results transfer. This is in line with the university's mission to benefit society through research.



王春明教授
Prof Wang Chunming

糖尿病足傷口敷料
A dressing for diabetic foot ulcers

免洗護膚凝膠
A rinse-free moisturising hand sanitiser gel

Tapping Sewage Sludge as a Source of High-Value Products

A research team at UM has developed a system to recover high-value resources from sewage sludge produced by municipal sewage treatment plants. The system was introduced to the Macao public during the Science and Technology Week 2021 cum Exhibition of Achievements in Science and Technology Innovation, which was organised by the Science and Technology Development Fund of Macao (FDCT) and supported by the Ministry of Science and Technology. The system can extract industrial-grade sulfated polysaccharides from residual sludge of secondary clarifiers in sewage treatment plants. The extract can be broken down into useful substances such as industrial-grade sodium alginate, carrageenan, and potassium alginate. The team, which has received two Chinese patents for developing the system, has been in talks with several environmental engineering companies and venture capital firms about collaboration through UM's Research Services and Knowledge Transfer Office (RSKTO).

In terms of technical maturity, the system has reached level 6 of the Technology Readiness Level (TRL), and tests conducted by an industrial partner have shown that the polysaccharides extracted by the system not only meet the Chinese quality standards for industrial-grade products; they can also produce algae products with the same degree of purity as those available on the market. The global demand for industrial-grade sulfated polysaccharides is growing rapidly, reaching USD 15.43 billion in 2021 alone. This contrasts with an acute shortage of conventional medical-grade sulfated polysaccharides, which are difficult and time-consuming to produce. 'Our system can be used at a wide range of urban sewage treatment plants. If the system treats 100 tons of sewage sludge per day, we can obtain about 1,300 tons of sulfated polysaccharides in a year,' says Hao Tianwei, head of the research team for the project. He is also an assistant professor at the Centre for Regional Oceans (CRO) and the Department of Civil and Environmental Engineering. 'If we sell the polysaccharides at 60 per cent of the current market price for industrial-grade products, our annual revenue could exceed RMB 10.4 million.'

Through the CRO, Prof Hao's team has continuously refined the process of extracting sulfated polysaccharides from sewage sludge in order to obtain medical-grade products. He points out that since 1987, when scientists discovered that sulfated polysaccharides could inhibit HIV, more potential functions of the polysaccharides have been revealed, such as the treatment of blood clots, immune inflammation, and tumours. 'We have confirmed that sulfated polysaccharides extracted from sewage sludge have anti-tumour and anticoagulant effects,' says Prof Hao.

'Tons of sewage sludge are produced every day when treating domestic sewage and industrial wastewater. Instead of burning it, why not use it and turn the waste into high-value products?' says Prof Hao, who also admits that by-products of sewage sludge are not yet widely accepted by the public due to prejudice. 'As of today, only India allows the use of sulfated polysaccharides from sewage sludge for medical purposes. We need to make more efforts to promote these research results in order to change people's minds.'

Traditional Chinese Medicine-based Innovative Products

Currently, three projects based on polysaccharides derived from Chinese medicinal herbs are being developed at UM, namely a dressing for diabetic foot ulcers, a glucomannan coating for bone tissue regeneration, and an alcohol-free and rinse-free antibacterial moisturising hand gel. The research results are being transferred at Genetrump Co, Ltd, a start-up company incubated at UM and partly owned by UMTec Limited. Some of the research results are close to the stage of clinical trials, while some others have been launched on the market. These achievements are the results of a research team at UM's State Key Laboratory of Quality Research in Chinese Medicine after a decade of hard work. In 2017, the team founded Genetrump, which moved into UM's Centre for Innovation and Entrepreneurship in the same year and received the first round of seed investment from UMTec Limited.

Technique and quality control are key in the process of transforming research results into finished products. 'Few medical products are available in the market for treating diabetic ulcers. Our dressing is developed from a natural compound derived from the plant Du Zhong (Eucommia ulmoides) and is effective in improving blood flow to affected areas in laboratory mice. In cases where our medicine is applicable, the dressing has the potential to significantly reduce the need for amputations in diabetic patients,' says Wang Chunming, associate professor in UM's Institute of Chinese Medical Sciences and head of the research team for the three projects. Prof Wang is also a recipient of the National Science Fund for Outstanding Young Scholars from the National Natural Science Foundation of China, and he is a 'Qi-Huang' Young Scholar recognised by the State Administration of Traditional Chinese Medicine. 'Many people develop osteoporosis as they age. Currently, we can use artificial implants such as titanium implants to strengthen the bones. To improve the integration of the implants and the bone in patients, we have developed a glucomannan coating, in the hope of giving patients the same quality of life as before. Because of the pandemic, we have also developed an antibacterial hand gel that is not only alcohol-free but also skin-friendly. According to tests conducted by a third-party institute, the gel can kill 99 per cent of bacteria and will not make the skin dry after use,' says Prof Wang.

The three research projects are supported by the FDCT and are among the results of the years of development of the Chinese medicine industry in Guangdong and Macao. The projects are also real-life examples of the development of the health industry in Macao with Chinese medicine R&D and production as the entry point. Prof Wang's team is seizing the opportunity brought by the Guangdong-Macao In-Depth Cooperation Zone in Hengqin during its development into a world-class centre for Chinese medicine production and innovation. The team is also taking advantage of the industry-academia platforms at the Zhuhai UM Science & Technology Research Institute (ZUMRI) and the Macau Institute for Translational Medicine and Innovation to commercialise its research results. The team will begin clinical trials with hospitals in order to launch the products on the market as soon as possible. According to Prof Wang, his team has procured industrial equipment for these three products and will soon set up production lines. 'We are also confident that these products will help to reduce health problems associated with the ageing population.' says Prof Wang.

Green Building Materials and Related Construction Technique Applied in Zhuhai

A construction technique using a special formula of cast-in-place nano-foam concrete developed by UM was tested in a pilot project in September 2021 in Henan province and was proven to be effective. The technique was subsequently applied in March 2022 in a project of China Construction Engineering (Macau) Company Limited in the Zhuhai National Hi-tech Industrial Development Zone, during which 5,000 cubic metres of nano-foam concrete was used to backfill a trench between the perimeter of the main structure underground and the maintenance pit. Compared to available materials on the market, UM's cast-in-place concrete solution uses 30 per cent less cement, significantly reducing material cost and carbon emissions.

This specialised concrete has been launched on the market by a building materials company in Zhongshan founded by UM professors and students with the support of ZUMRI. The company has also set up production lines in cities such as Nantong in Jiangsu province and Taiyuan in Shanxi province to produce nano-foam concrete boards, another type of green building material developed by UM. According to Sun Guoxing, associate professor in the Institute of

Applied Physics and Materials Engineering and head of the research team for the project, construction techniques and products using nano-foam concrete have matured and have entered the stage of market expansion. 'Innovation in materials is the basis for innovation in industrial development, especially in the construction sector. In the process of exploring opportunities to commercialise our research results, we have found that material innovation together with technical innovation can drive the mass production of new materials and the development of industries.' says Prof Sun.

According to a report on the energy consumption of buildings in China released in 2020, the construction sector accounted for 46.5 per cent of the total energy consumption in the country in 2018, and cement production was a major source of carbon emissions. The lightweight and high-strength nano-foam concrete developed by Prof Sun's team can significantly reduce cement consumption, improve the insulation capacity of buildings, and reduce energy consumption and carbon emissions during the heating and cooling processes in buildings. 'Our nano-foam concrete is also suitable for cast-in-place projects such as roof insulation, floor damping, aerial structures (such as sky pools), road construction, and the backfilling of large mines. Using our material, we can reduce cement consumption by 30 per cent to greatly cut the cost of materials. The capacity for constant thermal insulation is also increased by 25 per cent,' says Prof Sun.

'With the data provided by China Construction Engineering (Macau) Company Limited and research platforms of the ZUMRI, we will continue to improve our cast-in-place concrete technique and investigate its downstream applications, so as to promote the commercialisation of our research results and the industry of green building materials in China,' adds Prof Sun.

Chip Research Results Transfer in Hengqin Entrepreneurship Valley

Taking advantage of the research capacity of the State Key Laboratory of Analog and Mixed-Signal VLSI (SKL-AMSV), UM continues to push the boundaries in advanced chip research. Through its robust system for research innovation and results transfer, the university aims to accelerate the commercialisation of its microelectronics research results and establish a brand identity for microchips developed in Macao.

Among these research results is VHunter, a nucleic acid detection kit based on digital microfluidic technologies developed at UM. The research team for this project turned its initial lab findings into a business project through incubation at UMTec Limited. In 2018, the team members established Digifluidic Biotech Ltd and received an initial round of investment from UMTec. With ZUMRI's support, the company was able to commercialise the research results in the Hengqin-Macao Youth Entrepreneurship Valley and the finished product has been launched on the market in mainland China.

Prof Mak Pui In, head of the research team for the project, who is also interim director of the SKL-AMSV and deputy director of UM's Institute of Microelectronics (IME), says that the university provided tremendous support for the team to market VHunter. 'Not only did UM license the patented chip technology to the new start-up, but the university also took an equity stake in the company. This is also the first time that UM has taken an equity stake in a company founded by its graduates,' says Prof Mak, who adds that Digifluidic plans to leverage the strengths of Macao and its partners to bring VHunter to the Southeast Asian market.

VHunter can be widely used in infectious disease prevention and control as it can rapidly and accurately detect pathogens of diseases such as respiratory diseases (including novel coronavirus and influenza A virus), cervical cancer, sexually transmitted diseases, and drug-resistant tuberculosis. The detection kit can also generate real-time reports when connected to a computer. In addition to medical diagnostics, VHunter is also suitable for measuring health indicators, examining animals and plants with diseases, and conducting food safety tests. The detection kit has been purchased and used by various entities, including the Zhuhai Center for Disease Control and Prevention, the Gongbei Customs, and the Doumen Aquatic Products Testing Center. It has also received the CE marking, which affirms the product's conformity with EU standards. The team is now in the process of registering VHunter as a medical device in mainland China.

Dynamic Wireless Charging System Attracts Industry Attention

With the help of the RSKTO, a dynamic wireless charging system developed at UM made its debut

動態無線充電系統充電效率高達94%
The dynamic wireless charging system reaches a charging efficiency of up to 94 per cent

林智聲教授
Prof Lam Chi Seng

at the Seventh Macau Industrial Products Show in 2020 and immediately attracted industry attention. In August 2021, the university signed an agreement with the Macao Water Supply Company Ltd. Based on this agreement, UM will provide wireless charging services for autonomous boats in local reservoirs, which will reduce labour costs by eliminating the manual operation of replacing batteries and using plug-in wired charging for the boats. This technology can also be applied to smart warehouses, where a dynamic wireless charging system can be installed on the ground to power warehouse robots around the clock, thus reducing the cost of manpower. Moreover, as the Macao Special Administrative Region government has been active in popularising electric vehicles, this technology can help to solve a dilemma facing the charging of these motorbikes — the diversity of charger types for different makes or models, as well as the high cost and safety hazards of the existing battery replacement cabinets in car parks. Formed by UM postgraduates from Macao, the research team for this project has founded a local company named Smarmac Technology Company Limited, which is specialised in designing and developing wireless charging systems and power electronics systems. The team hopes to commercialise this technology and apply it in different scenarios in Macao and other parts of the Greater Bay Area to contribute to the moderate economic diversification of Macao.

There are currently around 320,000 warehouses in mainland China, but less than 20,000 of them are considered smart warehouses. Lam Chi Seng, head of the research team for the project, who is also an associate professor at the SKL-AMSV and the IME, says that the market potential for this technology is huge, adding that the dynamic wireless charging technology developed by his team can meet the needs of the smart warehouse market. 'The greatest strength of our system is its high charging efficiency of up to 94 per cent, which is better than similar wireless charging products on the market. Even with a 20 per cent misalignment from the charging position, the high charging efficiency is still guaranteed.' says Prof Lam.

Macao has been striving to build a world-class smart city in recent years, with the goal of providing more high-quality services for its residents through smart basic infrastructures. Smart transport is one of the initiatives. The first step towards this development is to fully automate electric vehicle charging. 'We can develop wireless charging receiver coil and circuit transmission pads for different makes or models of electric vehicles to achieve the most efficient wireless charging. When electric vehicles pass through the road paved with a wireless charging transmitter coil, they can be charged immediately.' says Prof Lam.

The construction of a smart city is not completed without implementing efficient, convenient, and user-friendly power supplies. Prof Lam hopes that the wireless transmitter coils will be installed in front of traffic lights or zebra crossings to enable wireless charging services for electric vehicles whenever they pass by, so that they can travel further.

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推動澳門醫藥創新成果轉化

Promoting the Transfer of Innovative Medical Research Results in Macao

文 / 張愛華．圖 / 編輯部．英文翻譯 / 蘇恩霆
Chinese / Ella Cheong．Photo / Editorial Board．English Translation / Anthony Sou

澳門大學的研究一直緊扣國家和澳門重大需求，並結合自身優勢在生物醫藥領域重點佈局，成果顯著。在澳大成立的澳門轉化醫學創新研究院以研發醫藥衛生產品為重要方向，推進醫學科技創新和轉化，支持澳門經濟和產業適度多元發展，助力粵港澳大灣區建設國際科技創新中心。

生物醫藥領域重點佈局

澳大是澳門一所綜合性公立大學，以科教強澳為己任，著眼澳門和國家重大需求，結合自身優勢在生物醫藥領域重點佈局。2010年，國家批准中醫藥領域第一個國家重點實驗室落戶澳門。經過11年發展，中藥質量研究國家重點實驗室（澳門大學）至2021年已發表2,800篇論文及專著，獲得50個專利，為10多種中藥制訂國際質量標準。實驗室已成為國際先進的中藥質量創新研究基地和國際合作平台，聚焦以中醫藥研發及製造為切入點的大健康產業、高新技術產業等重點產業，走出一條澳大科研成果產業化道路。

在精準醫學領域，澳大在2021年獲批准建設全國唯一的教育部精準腫瘤學前沿科學中心，也是國家在港澳地區的首個前沿科學中心。該中心致力引領生命科學、醫學，尤其是癌症等方面的研究與發展，促進大健康發展，為澳門、粵港澳大灣區及全國癌症患者群提供精確的診斷和治療。

澳大校長宋永華教授表示，大學除了優化自身科研平台產出，還有策略地與其它高等院校及企業合作增強科研實力，包括與香港中文大學建立聯合腫瘤實驗室；與廣州金域醫學檢驗集團股份有限公司建立聯合創新實驗室；與華潤集團、廣藥集團和中國中醫科學院等共同創立澳門中藥研發中心，以產學研項目合作形成澳門中藥研發共性技術平台。

推動中醫藥產學研發展

澳大作為第一所在橫琴島上建設校園的澳門高等院校，將發揮自身地理優勢及在生物醫藥領域的科研力量，推動中醫藥產學研發展，支持澳門經濟和產業適度多元發展，助力大灣區建設國際科技創新中心。在澳門經濟及科技發展局和科學技術發展基金支持下，澳大邀請到在生物醫學領域有突出貢獻的中國工程院院士鍾南山指導成立澳門轉化醫學創新研究院（以下簡稱研究院），並任指導委員會主席。

研究院將以中醫藥及生物醫藥領域轉化項目作為首階段重要任務。澳門特區政府經濟財政司司長李偉農在研究院揭牌儀式上表示，將會重點支持研究院發展中醫藥產業，尤其是推動澳門中藥質量研究國家重點實驗室及澳大其他學院的相關科研成果落地。

鍾南山院士期望，研究院在澳門特區行政長官賀一誠指導下，充分利用橫琴粵澳深度合作區及大灣區政策紅利，發揮科研與產業轉化的橋樑作用，加速科技創新轉化，促進灣區融合、藥品監管互認等。研究院在開展成立前期工作時，鍾南山院士及其團隊組織了大批內地藥企推薦期望赴澳門轉化的品種，他說：「我們已通過第一批遴選，選擇了幾個優秀品種，接下來將廣泛收集國內外優秀品種，遴選推薦至澳門進行轉化落地。並且形成工作機制，在研究院建成集成果評估、轉化服務、知識產權服務、產品註冊服務等於一體的創新轉化體系。」

研究院將會以研究醫藥衛生產品為重要方向，致力高效推進醫學科技創新和轉化，提升大灣區疾病防治水平，以創新中藥為其重點任務。宋永華教授表示，澳大將透過整合海內外相關領域頂尖團隊的轉化經驗，建立一套穩定而有效的機制，開展成果轉移轉化。他說：「為響應特區政府規劃，其中將推進的成果轉化項目包括澳大研發的碳量子點腫瘤免疫治療技術及糖尿病足傷口敷料。研究院將協助挖掘和培育澳門本地有一定基礎、有商業價值的科研成果，結合內地市場，加速在大灣區轉化，促進中醫藥產業化，繼而推動產品和服務拓展國際市場。」

澳門特別行政區行政長官賀一誠（右二）、中央人民政府駐澳門特別行政區聯絡辦公室主任傅自應（左二）、中國工程院院士鍾南山（右一）和澳大校董會主席林金城為澳門轉化醫學創新研究院揭牌。

Ho Iat Seng (2nd from right), chief executive of the Macao SAR; Fu Ziying (2nd from left), director of the Liaison Office of the Central People's Government in the Macao SAR; Zhong Nanshan (1st from right), member of the Chinese Academy of Engineering; and Lam Kam Seng, chair of the University Council of UM, unveil a plaque of the Macau Institute for Translational Medicine and Innovation.

澳門特別行政區政府經濟財政司司長李偉農

Lei Wai Nong, secretary for economy and finance of the Macao SAR government

Over the years, the University of Macau (UM) has been committed to addressing the major needs of China and Macao through research. Building on its strength in biomedical sciences, the university has developed a strategic plan to advance its development in this field and has made remarkable results. Among these initiatives, the recently inaugurated Macau Institute for Translational Medicine and Innovation (MITMI) at UM attaches great importance to the development of medical and health products. Through the institute, UM aims to promote technological innovation and transfer in medical sciences, thereby contributing to the diversification of Macao's economy and the development of the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) into an international centre for technological innovation.

Strategic Planning for Biomedical Sciences

As a comprehensive public university in Macao, UM strives to promote the city's development through science and education. In 2010, the university received approval from the central government to establish the State Key Laboratory of Quality Research in Chinese Medicine (SKL-QRCM), the first of its kind in China. As of 2021, 11 years after its establishment, scholars associated with the lab had published 2,800 research articles and books, obtained 50 patents, and established international quality standards for more than ten Chinese medicinal plants. It is now an internationally advanced research and innovation centre as well as a platform for international cooperation. The lab is committed to supporting several key sectors, including high-tech industries and the health industry, with Chinese medicine R&D and production as an entry point, creating a pathway for the commercialisation of UM research results.

In the field of precision medicine, in 2021 UM established the Ministry of Education Frontier Science Center for Precision Oncology, which is the only frontier science centre in its field in China and the first-ever frontier science centre in Hong Kong and Macao. The UM centre aims to advance R&D in life sciences and medicine, with a strong emphasis on cancer treatment, in order to promote the health industry and provide accurate diagnosis and treatment for cancer patients in Macao, the GBA, and across China.

According to UM Rector Yonghua Song, in addition to enhancing the output of its various research platforms, the university has entered into strategic partnerships with other universities and enterprises to expand its research capacity. These partnerships include a joint oncology lab with the Chinese University of Hong Kong and a joint innovation lab with Guangzhou Kingmed Diagnostics Group Co Ltd. UM has also established a centre for R&D in Chinese Medicine with China Resources Holdings Company Limited, Guangzhou Pharmaceutical Company Limited, and the China Academy of Chinese Medical Sciences. The centre serves as a collaborative research platform for Chinese medicine in Macao through industry-academia collaboration.

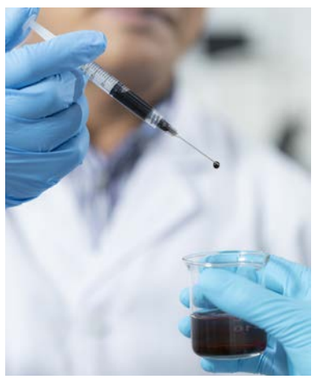
Advancing Industry-Academia Collaboration in Chinese Medicine

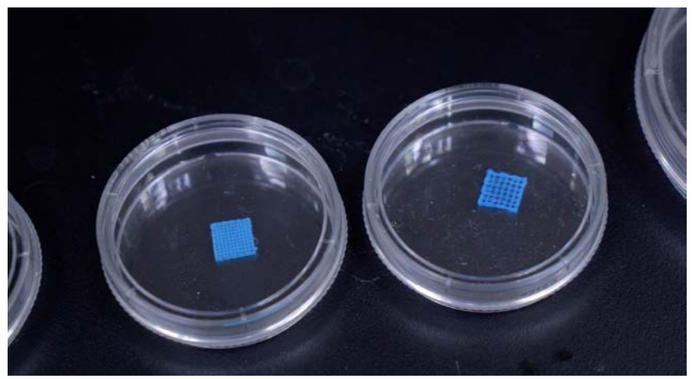
As the first higher education institution in Macao to build its campus on Hengqin island, UM leverages its advantages in geography and research capacity in biomedical sciences to advance industry-academia collaboration in Chinese medicine. In this way, the university will be able to contribute to the moderate economic diversification of Macao, as well as the development of the GBA into an international centre for technological innovation. With the support of the Macao Economic and Technological Development Bureau and the Science and Technology Development Fund of Macao, the university invited Zhong Nanshan, a member of the Chinese Academy of Engineering with outstanding achievements and contributions in the field of biomedical sciences, to guide the establishment of the institute and serve as president of its steering committee.

MITMI will take the development of Chinese medicine and biomedicine as its key task during the initial stage. At the inauguration ceremony for the institute, Lei Wai Nong, secretary for economy and finance of the Macao SAR government, said that the government would provide major support for the institute to transfer research results of Chinese medical sciences, especially those produced by the SKL-QRCM and other UM units.

Zhong expressed his hope that MITMI would follow Macao SAR Chief Executive Ho Iat Seng's instructions to take advantage of the preferential policies for the Guangdong-Macao In-Depth Cooperation Zone in Hengqin and the GBA, and give full play to its role as a bridge between scientific research and industrial transformation, in order to promote the integration of the GBA and the mutual monitoring and recognition of medicines. In the preliminary stage of the institute's establishment, Zhong and his team organised many mainland pharmaceutical companies to recommend outstanding research results for transfer in Macao. 'We have selected the first batch of outstanding research results for transfer at the institute,' says Zhong. 'The institute will continue to search for research results with great potential from China and abroad and transform them into products in Macao. The institute will also create a mechanism as the foundation of an integrated system for result evaluation, technology transfer, IP-related services, and product registration.'

In addition, one of the major directions of MITMI will be to promote the development of medical and health products. The institute will efficiently promote innovation in medical science and technology, and enhance disease prevention and treatment in the GBA, with the development of innovative Chinese medicine-based drugs as its key mission. According to Prof Song, UM actively draws on the experience of leading research teams from China and abroad to build a stable and effective mechanism for research results transfer. 'The institute was established in response to the SAR government's plan. Projects to be promoted include a cancer immunotherapy based on carbon-quantum-dots and a dressing for diabetic foot ulcers developed by UM researchers,' says Prof Song. 'The institute will also help cultivate local scientific research results with commercial value, and accelerate their commercialisation in the GBA, so as to promote the industrialisation of Chinese medicine and the expansion of products and services in the field to the global market.'



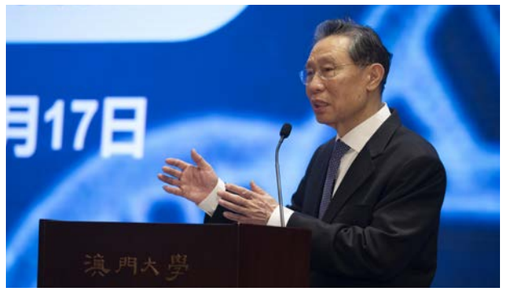


澳門轉化醫學創新研究院將推進的成果轉化項目包括澳大研發的碳量子點腫瘤免疫治療技術及糖尿病足傷口敷料

MITMI will promote UM projects, including a cancer immunotherapy based on carbon-quantum-dots and a dressing for diabetic foot ulcers

澳大校長宋永華

UM Rector Yonghua Song



中國工程院院士鍾南山

Zhong Nanshan, a member of the Chinese Academy of Engineering

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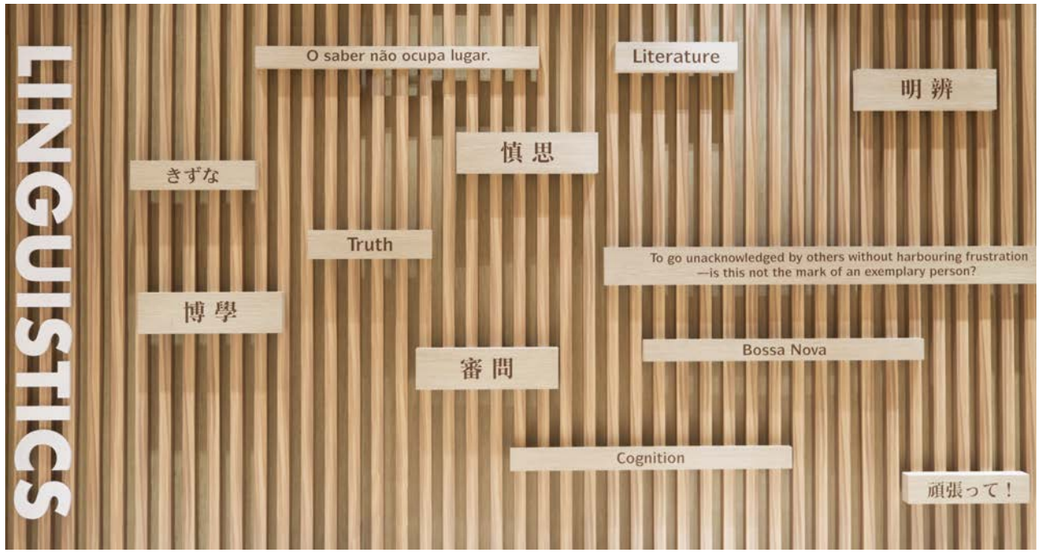


多元文化下之語言教學

Language Education in a Multicultural Context

文 / 余偉業．圖 / 何杰平、資深校園記者陶一瑋．英文翻譯 / 蘇恩霆
Chinese / Kelvin U．Photo / Jack Ho, Senior UM Reporter Tao Yiwei．English Translation / Anthony Sou

澳門大學是一所國際化綜合性公立大學，坐落於澳門這座中西合璧、文化多元的歷史名城，校園更匯聚了一批來自世界各地的語言學家。他們在多語多文化的環境和氛圍中如何傳道授業？如何開展學術探索？如何在語言教學上結合澳門獨一無二的人文背景，開闢出一條特色鮮明的澳大之路？

澳門獨特的語言景觀

澳門獨有「三文四語」（三文：中文、葡文、英文；四語：廣東話、普通話、葡語、英語）的語言景觀。人文學院院長、語言學研究中心主任徐杰教授說，現代澳門由歷史和現實多重因素交織而成，彈丸之地多語通行，多種文化和文明並存，素有「多元文化的鮮活博物館」和「多種語言的天然實驗室」的美譽。

徐教授說：「特殊的歷史際遇、特殊的地理位置、特殊的經濟生活、特殊的政治生態決定了澳門多語言、多文化和諧共存的特殊狀況。澳門僅有30多平方公里土地和60多萬居民，通行的語言竟達兩位數。多種中西文化長期並存融合，廟宇和教堂數百年來毗鄰而立，堪稱舉世經典。澳門自然形成的多語多文化生態恰好為研究語言文化接觸、語言文化變異、不同語言文化相互影響和融合提供一個難能可貴、近乎完美的語言文化研究社區樣本，已經成為一個理論意義深邃、實踐價值重大的世界級研究課題群。」

學語言的重要性

徐教授表示，他最自豪的是人文學院有一支優秀而高度國際化的師資團隊，成員各有所長，來自世界著名學府。多數學者曾在全球各地教學和研究，專長涵蓋文學、歷史、哲學、語言、翻譯和藝術等人文學科核心領域。徐教授說：「澳大在各個人文領域著重培養學生的語言能力，強調大學語言教育的重大意義。」

徐教授說：「語言能力與語言教學的重要性，怎樣強調也不過分。」他概括指出，語言有三大功能，不僅是交際工具和文化認同符號，還是思維平台。語言是獲取、消化、整合和創新知識等活動的平台。語言能力包括母語能力和外語能力，代表了我們的核心能力和核心競爭力。對絕大多數人而言，在絕大多數生活和工作場景中，語言能力強，其它能力亦不會弱。語言能力體現綜合能力；提升語言能力，也可顯著提升綜合能力。

「如果說數學是理工農醫各學科的基礎學科、歷史是人文社科各學科的背景學科，語言則可說是所有學科的基礎學科。現代人所謂的4C核心能力：溝通能力（Communication）、批判性思考能力（Critical thinking）、合作能力（Collaboration）和創新能力（Creativity）直接或間接都跟語言能力密切相關。」

培養語言人才配合社會發展

徐教授表示，人文學院的語言教學在學術界久負盛名，其中中國語言文學系兼採海內外之長，融會貫通，並跟北京大學中國語言文學系、香港大學中文學院和台灣大學中國文學系構築了中文學界最高水平的四校交流合作平台。葡文系更在同類學系中首屈一指。英文系和日本研究中心多年來將語言教學與跨文化交際能力密切掛鈎，極具創意和成效。

徐杰教授
Prof Xu Jie

英語在澳門的使用可追溯到17世紀上半葉英國商人抵澳。英國東印度公司18世紀初在澳設立據點。澳大語言學研究中心副主任、英文系副教授Andrew Moody是世界英語專家，致力於記錄澳門悠久的多語傳統，著有《Macau's Languages in Society and Education》一書。他是少數嘗試全面審視澳門語言歷史和教育的西方學者，目前是英國劍橋大學出版社出版的語言學刊物《English Today》的主編。該刊以長期探討英語在新時代的全球傳播和演變見稱，在學術界舉足輕重。

他表示，澳門在1842年前是華南的英語文化中心，當時英語已對澳門多語言和多文化的發展構成影響，但這段歷史已被遺忘。「澳門自1999年回歸後，來自亞洲和歐美的投資漸增，不僅需要能以英語交際的人才，更要根據不同專業的需求培養高級英語人才。倘若澳門能留住這些人才，將會有利於打造和提升澳門作為世界旅遊休閒中心的地位。」

Moody教授指出：「在21世紀，學習英語不再僅為與母語是英語的人溝通，而是為了跟世界各地的人交流。正因如此，許多一流高等學府一直堅持以英語能力為最基本的學術要求。」

課程改革強化學術英語

澳大英語中心肩負著提高學生學術英語水平的重任。中心研究學生的學習需求和合適的教學方法已有數年，今年推出英語課程改革，期望提高學生在其學科的學術英語水平。英語中心主任、人文學院應用語言學副教授陳海瑛表示，課程改革旨在促使畢業於中文中學的新生更加適應澳大的全英語教學環境，滿足其學習需求。

過去幾年，英語中心就社會科學、工商管理和先進科技等領域對英語水平的要求諮詢多間學院的教授。此外，為開發「大學英語1-3」基礎級課程，英語中心對比了市面上的學術英語教材，最後決定採

用牛津大學出版社的學術英語系列教材。中心的教學團隊按該系列教材設計了專題導向項目的學習材料、加入互動式Moodle活動，並採用混合模式的多媒體教學，藉此提升學生聽說讀寫的能力，協助他們學習語法和學術詞彙。新的中級英語課程則使用由中心的教學團隊設計、曾獲英國文化協會英語教程設計獎的教材，注重學術領域的語言學習。學生不僅能從中磨練學術論文寫作、討論和演講等方面的技巧，還能以學術英語學習解讀、評價和生產知識的過程。

陳教授指出，新的英語課程和輔助式英語聯合教程活動的另一特色是推動具全球視野的英語技能學習（Mercer, et al. 2019）[1]，滲透批判性、創造力、團隊協作、數碼化思維、健康、跨文化能力和公民意識等概念。2022年，英語中心擴大了英語聯合教程活動的範圍，加強支援學生在課堂外學習學術英語。

大部分學生認為，新的學術英語教程有一定挑戰性，有助他們掌握更多學術詞彙和提升英語表達能力，並認為過程寫作、演講的教學方法有效，其英語水平和信心逐步提高。

沉浸式語言環境促葡語習得

澳大葡文系是葡萄牙和巴西以外最大的葡語學術單位，與葡萄牙的高等院校開展高水平的人才聯合培養項目，致力培養和輸送中葡雙語人才，助力澳門搭建中國與葡語國家商貿合作服務平台。

應用語言學家、中葡雙語教學暨培訓中心副主任、葡文系副教授Ana　Nunes在澳大任教13年，期間曾修讀中文課程，學習中文發音和語法結構，也曾自學粵語和普通話在語音和音韻的特性，她透過比較中葡兩種語言的語音特點，幫助學生克服學習葡語時的障礙。Nunes教授亦曾發表相關主題的論文，與學界分享心得：「我們的課程根據學生年齡、語言程度和學習需要而設置，不同科目環環相扣。教授會向學生闡明各科目的學習目標，期望學生也能確立自己的學習進度和成果。學生經過四年學習，基本能說一口流利的葡語，甚至可達歐洲共同語言參考標準B1或B2級別。」

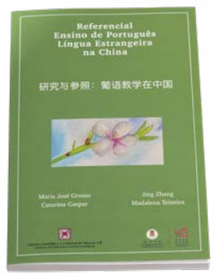
張靜教授
Prof Zhang Jing

沉浸式的葡語環境有利成年學生學習。文學士學位（葡語研究）課程主任、葡文系助理教授張靜表示，根據其多年的教學經驗，在不同的人生階段有不同的語言學習優勢，如大學生的學習動機明確、專注力更持久和讀寫技能良好。她去年與在葡文系任教多年，現為該系訪問教授的里斯本大學文學院副教授Maria José Grosso等學者合作，分析母語為中文的成年葡語學生的學習情況和挑戰，並出版了《研究與參照：葡語教學在中國》一書，呈現中國內地和澳門葡語教學的現狀。

張教授指出，澳大葡語教學資源優渥，學生可在第三學年到葡語國家的大學學習，有助他們吸收葡語知識和理解當地文化。「澳門中西交融，造就了澳大多元文化的基因，亦有助學生從城市的人文肌理和大學的多語學術環境中應對葡語學習的挑戰。」

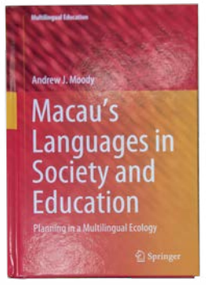
構建世界級中國文化學術重鎮

漢語語言學家徐杰教授曾獲長江學者講座教授榮銜，在中國內地、美國和新加坡任教和研究20多年，2008年加盟澳大。他在出任人文學院院長前曾任中國語言文學系主任。



張靜教授與Maria José Grosso教授等學者合著《研究與參照：葡語教學在中國》

Framework Teaching Portuguese as a Foreign Language in China, co-authored by Prof Zhang Jing, Prof Maria José Grosso and other scholars



Andrew Moody教授的專著《Macau's Languages in Society and Education》

Prof Andrew Moody's book *Macau's Languages in Society and Education*

徐教授表示，中國語言文學系是澳大重點發展的學系之一，師資雄厚，學術精湛。「多樣性是學術發展的動力和泉源。每個學術機構都要發展出自己的特色。中國語言文學系在教學和研究時提倡世界視野、離開國學看國學，將中國的語言文學現象放在整個人類社會所可能具有的語言文學總體樣式和總體格局的大框架下探討。我們要用世界語言講中國故事、用世界語言講澳門故事。」

跨文化研究實力雄厚

澳大的語言學教授在語言和文化研究領域實力雄厚，成果豐碩。過去五年（2017-2021），他們在《中國語文》、《當代語言學》、《World Englishes》、《Lingua》、《Journal of Pragmatics》等學術期刊發表超過250篇論文。此外，由澳大編輯出版的綜合性人文社會科學學術期刊《南國學術》在「2020年度複印報刊資料轉載率排名」的「中國高等院校主辦學報排名」位列第三。徐教授表示，相對於國內其他大學，澳大在比較語言學、應用語言學、翻譯學等領域特色鮮明、優勢突出。

As an international comprehensive public university, the University of Macau (UM) is rooted in Macao, a historic city with a unique blending of eastern and western cultures that has not only given rise to a multicultural and multilingual environment, but has also made the university home to linguists from around the world. In what ways has the local environment in Macao influenced their teaching and research? How have they taken advantage of Macao's cultural distinctiveness to make language education unique at UM?

Andrew Moody教授
Prof Andrew Moody

語言人才出路廣闊

過去10年，人文學院培養了超過3,300名畢業生，在世界各地發展，例如從事教育、翻譯、商貿、行政等，也有不少人到芝加哥大學、波士頓大學、上海交通大學、香港中文大學和香港大學等知名學府深造。徐教授指出，內地50多家開辦葡語課程的高校的教師，以及澳門的中文教師和葡語教師，很多都是澳大畢業生。「隨著社會和經濟發展，愈來愈多公私營機構，包括銀行、貿易公司、科技企業和政府部門，都需要精通『三文四語』的人才，這些機構每年都聘請很多澳大畢業生。」

徐教授強調，澳大的中國語言文學系、英文系、葡文系和日本研究中心致力為國家和澳門培育優秀的語言人才：「具備語言優勢的學生無論在澳門、粵港澳大灣區其它地方，還是世界各地，都能找到發揮才能的舞台。」

Macao as a Linguistically Diverse Community

Macao is a one-of-a-kind city with three primary written languages (Chinese, Portuguese, and English), and four primary spoken languages (Cantonese, Mandarin, Portuguese, and English). Prof Xu Jie, dean of the Faculty of Arts and Humanities (FAH) and director of the Centre for Linguistics, has often referred to Macao as a 'living museum of languages' or a 'natural laboratory for multilingualism'. This is the result of the city's historical development over the centuries and a reflection of the inseparable

relationship between language and society.

‘Macao's unique history, geographical location, economic structure, and political landscape have all contributed to the coexistence of different languages and cultures among its people,’ says Prof Xu. ‘Although the city has an area of just over 30 square kilometres and a population of only about 600,000, the number of languages spoken here is in double figures. Moreover, there has been a long-standing fusion of Chinese and western cultures. Chinese temples and churches being in the same neighbourhood for hundreds of years is an iconic example of multiculturalism. Thanks to the multilingual and multicultural ecology of the city, Macao provides a rare and almost perfect model of a linguistic and cultural research community for the study of linguistic and cultural contact, linguistic and cultural variation, and the interaction and integration of different languages and cultures. The environment also gives rise to a group of first-rate research topics with profound theoretical significance and practical value.’

The Importance of Language Learning

Prof Xu is most proud of the outstanding international faculty team in FAH. Most of the faculty members engaged in teaching or research at renowned universities around the world before joining UM, and their academic expertise spans the core areas of the humanities, including literature, history, philosophy, languages, translation and the arts. Within the humanities, Prof Xu highlights the importance of developing students’ language skills and promoting language education at the university level.

‘The importance of language skills and language learning cannot be overemphasised,’ says Prof Xu. He contends that language is not only a tool for communication and a symbol of cultural identity, but it also provides a platform for intellectual activities such as acquiring, digesting, integrating, and innovating knowledge. Language skills, namely the command of both native and foreign languages, can also represent a person’s core competencies and competitiveness. Prof Xu further believes that people with strong language skills will be less likely to show poor abilities in other areas, and that language proficiency is itself a manifestation of a person’s overall quality and contributes to all of his or her abilities.

‘Just as mathematics is the foundation of science, engineering, agriculture, and medicine, and history is the background to humanities and social sciences, language is the foundation of all disciplines,’ says Prof Xu. ‘The 4Cs, namely the four core areas of general competence in modern times, are communication, critical thinking, collaboration, and creativity. All of these are directly or indirectly related to language skills.’

語言學研究中心於2022年成立，匯聚不同學術單位的語言學家，全面推進跨語種學術的研究，進一步貢獻澳門語言學科的發展。

Established in 2022, the Centre for Linguistics aims to bring together linguists from different academic units to promote cross-linguistic research and further contribute to linguistic disciplines in Macao.

Nurturing Language Professionals to Meet Social Development Needs

Prof Xu adds that FAH has a long-standing reputation for language education in the academic community. The Department of Chinese Language and Literature draws on the strengths of studies both in the mainland and overseas. The department, together with the Department of Chinese Language and Literature at Peking University, the School of Chinese Studies at the University of Hong Kong, and the Department of Chinese Literature at Taiwan University, has established an inter-university platform for exchange and collaboration at the highest level in Chinese language studies. The other departments in FAH have their own strengths — The Department of Portuguese is one of the best of its kind, while the Department of English and the Centre for Japanese Studies have for many years been innovative and effective in linking foreign language teaching with intercultural communication skills.

The use of English has a long history in Macao; British traders began arriving in the first half of the 17th century and the British East India Company established a presence in Macao around the start of the 18th century. Andrew Moody, deputy director of the Centre for Linguistics and associate professor in the Department of English, is an expert in the study of world Englishes and one of the few western scholars who has attempted to compile a comprehensive examination of the history of languages and language teaching in Macao. His research is committed to documenting Macao’s long tradition of multilingualism and he has published *Macau’s Languages in Society and Education*, offering a macro-sociolinguistic examination of English within the multilingual ecology of languages in Macao. He is also currently the editor of *English Today*, a prestigious academic journal published by Cambridge University Press; the journal is especially known in the academic circle for its debates on the evolution of English over time.

陳海瑛教授

Prof Katherine Chen

‘Macao was the centre of English-speaking culture in South China before 1842, but that is a type of forgotten history. At that time, English speakers were already influencing the multilingual and multicultural development of the city,’ says Prof Moody. ‘Since the 1999 handover and with more and more investment in Macao coming from Asia, Europe, and the United States, we see a growing demand for English speakers that are not only proficient in the language for daily communication but also capable of developing professional skills based on the needs of local industries. To the degree that Macao can successfully retain this talent within the territory, this would help build Macao into a world-class tourism and leisure centre.’

‘In the 21st century, students no longer learn English simply to communicate with native speakers, but they are also driven to exchange knowledge with people from around the world. This is why the world’s leading universities have insisted that proficiency in English is a basic academic requirement,’ adds Prof Moody.

Curriculum Reform to Strengthen Students’ Academic English Proficiency

The English Language Centre (ELC) at UM is committed to improving the academic English proficiency of students. After several years of researching UM student needs and effective pedagogy for their learning contexts, this year the centre officially launched a reformed English language curriculum to target and strengthen students’ academic English proficiency in university disciplines. According to Prof Katherine Chen, director of ELC and associate professor of applied linguistics in FAH, the curriculum reform aims to better meet the academic learning needs of new students from Chinese-medium secondary schools as they adapt to the English-medium education environment at UM.

Through the years, the centre consulted faculty members about students’ academic English needs in areas such as social sciences, business administration, and advanced technology. To develop foundational-level courses, namely University English 1-3, the centre surveyed available general academic English teaching materials in the market and decided to adopt an academic English textbook series from Oxford University Press (OUP) into project-based learning materials and interactive Moodle activities, which incorporate blended-mode multimedia teaching that complements the learning of the four language skills (speaking, reading, writing and listening), grammar, and academic vocabulary among students. The intermediate-level courses in the new curriculum use ELC’s in-house designed material, including a course that won the British Council English language teaching design award, and focus on academic research-based learning. Students not only hone specific English skills for academic essay writing, discussion, and presentation, but also learn the process of knowledge interpretation, evaluation, and production in the context of English for general academic purposes.

Prof Chen remarks that another significant feature of ELC's new curriculum and the complementary English co-curricular activities is the emphasis on global skills learning (Mercer, et al. 2019)[1], which incorporates concepts such as critical, creative and collaborative thinking, digital literacy, learners' wellbeing, as well as intercultural competence and citizenship. In 2022, ELC is expanding its English co-curricular activity arm to strengthen support for English learning and academic skills learning outside the classroom.

Despite finding the academic English curriculum quite challenging, many of the students noticed an increase in their academic vocabulary and expressions. In addition, they appreciate the pedagogy of process writing and presentation, which scaffold learning to allow them to improve language skills and build up confidence.

Immersive Language Environment for Portuguese Language Acquisition

As the largest academic unit for Portuguese language studies outside Portugal and Brazil, the UM Department of Portuguese has collaborated with Portuguese universities to develop high-level joint programmes, with the aim of nurturing bilingual professionals in Chinese and Portuguese to support Macao's goal of building a platform for economic and trade cooperation between China and Portuguese-speaking countries.

Ana Nunes, an expert in applied linguistics who is also deputy director of the Chinese-Portuguese Bilingual Teaching and Training Centre and associate professor of Portuguese, has been teaching at UM for 13 years. Over the years, she has taken Chinese classes to learn Chinese pronunciation and grammatical structure, and has self-studied some particularities of phonetics and phonology of Cantonese and Mandarin. One of her methods to help students overcome difficulties in learning Portuguese is to show them the differences between the phonetic features of Chinese and Portuguese. She has also written a number of papers to share her teaching experience in the academic circle. 'Our curriculum is tailored to the age, language level, and learning needs of students and the subjects are interlinked with each other. In the courses, students are given clear goals for their studies and are expected to monitor their learning progress and outcomes,' says Prof Nunes. 'Generally speaking, after four years of studies, students will be able to speak Portuguese fluently, and can even reach the B1 or B2 level of the Common European Framework of Reference for Languages.'

An immersive Portuguese language environment is also beneficial to adult learners. Zhang Jing, coordinator of the Bachelor of Arts in Portuguese Studies programme and assistant professor in the Department of Portuguese, says that based on her years of teaching experience, she believes that people in different stages of life have different language learning advantages. For example, university students have a clear motivation to learn with good concentration ability as well as reading and writing skills. She has worked together with several scholars, including Maria José Grosso, a long-time faculty member and visiting professor in the department, who is also an associate professor in the Faculty of Arts at the University of Lisbon, to conduct a study of adult learners of Portuguese who are native Chinese speakers. The study aimed to analyse the current situation of adult learners and the challenges facing them. The scholars also published a book titled *Framework Teaching Portuguese as a Foreign Language in China*, which aims to help readers understand the current development of Portuguese language teaching in mainland China and Macao.

Prof Zhang also points out that UM has excellent resources in Portuguese language education. The university supports students to study at universities in Portuguese-speaking countries in their third year, which can have a positive impact on their acquisition of Portuguese language skills and understanding of the local culture. 'Located in a city with a mixture of both Chinese and western cultures, UM has developed its multicultural DNA,' says Prof Zhang. 'The unique cultural fabric of the city and the multilingual academic environment of UM can help students overcome the challenges of learning Portuguese.'

Building a World-Class Centre for Chinese Studies

Prof Xu is an expert in Chinese linguistics and a Chang Jiang Scholar Chair Professor. Before joining UM in 2008, he held different positions in teaching and research in mainland China, the United States, and Singapore for more than 20 years. At UM, he served as head of the Department of Chinese Language and Literature before becoming dean of FAH.

Ana Nunes教授
Prof Ana Nunes

According to Prof Xu, the Department of Chinese Language and Literature is one of the university's key departments, with a strong faculty team and high academic standards. 'Diversity is the driving force behind academic development and each academic department should try to find its speciality,' says Prof Xu. 'In our department, we advocate a global perspective and aim to explore the phenomenon of Chinese language and literature within the larger framework of human language and literature, in order to tell the stories of China and Macao in a way that people around the world can understand.'

Strong Cross-cultural Research Capacity

Linguistics scholars at UM have achieved many outstanding results in language and cultural studies. From 2017 to 2021, they collectively published over 250 papers in academic journals, such as Studies of the *Chinese Language, Contemporary Linguistics*, *World Englishes*, *Lingua*, and *Journal of Pragmatics*. In addition, *South China Quarterly*, a comprehensive academic journal in the humanities and social sciences edited and published by UM, was ranked third in sharing rate among all academic journals published by Chinese higher education institutions in 2020. According to Prof Xu, these achievements are testament to UM's distinctive features and clear advantages over its counterparts in China in areas such as comparative linguistics, applied linguistics, and translation studies.

Multiple Career Paths for Language Professionals

Over the past decade, FAH has produced over 3,300 graduates who have gone on to pursue careers in areas such as education, translation, business, and administration worldwide, or to pursue further studies at prestigious universities, such as the University of Chicago, Boston University, Shanghai Jiao Tong University, the Chinese University of Hong Kong, and the University of Hong Kong. Graduates of UM's Chinese and Portuguese programmes are not only hired by local schools as language teachers — some of them have found job opportunities in the more than 50 universities with Portuguese language programmes in mainland China. 'With the development of our society and economy, more and more employers, including banks, trading companies, tech companies, and government departments, feel the need to hire professionals who are fluent in Chinese, Portuguese, and English. Many of our graduates are employed by these companies every year,' says Prof Xu.

He adds that the Department of Chinese Language and Literature, the Department of English, the Department of Portuguese, and the Centre for Japanese Studies are committed to producing language professionals for China and Macao. 'Students with language skills can always find opportunities to showcase their talent, no matter whether they are in Macao, in the Guangdong-Hong Kong-Macao Greater Bay Area or other parts of the world,' says Prof Xu.

1 Mercer, S., Hockly, N., Stobart, G., & Galés, N. L. (2019).《全球技能：培養運籌帷幄的21世紀公民》。牛津大學出版社英語教學專家組，牛津大學出版社。
Mercer, S., Hockly, N., Stobart, G., & Galés, N. L. (2019). *Global skills: Creating empowered 21st century citizens*. OUP English Language Teaching Expert Panel, Oxford University Press.

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朱智豪：經濟學家應先天下之憂而憂

Angus Chu: Economists Need to Be Visionary When Solving the World's Problems

文/余偉業・圖/何杰平、編輯部・英文翻譯 / 陳靜
Chinese / Kelvin U・Photo / Jack Ho, Editorial Board・English Translation / Ruby Chen

經濟學是一門探索人類社會經濟活動與規律的學科。東晉時代葛洪在《抱朴子・內篇》提出「經世濟俗」，即經濟學家須有經國濟民的胸懷。澳門大學經濟學系主任朱智豪特聘教授求學時遇上亞洲金融風暴，激發他研究金融危機，今日已躋身全球排名前10%的經濟學家之列。他胸懷濟世之志，認為「經濟學家應先天下之憂而憂，以研究為基石為社稷解困、謀福祉。」

一場風暴激發鑽研金融危機

就本源而言，經濟學是一門探索人類社會經濟活動與規律的學科。到了21世紀，經濟學在社會科學領域的影響力不斷擴張，並把人們的主觀意識和行為納入研究範圍。經濟學分析已經廣泛應用於商業、金融、公共行政等範疇。朱教授認為，研究經濟問題時除了要有紮實的理論知識和懂得運用數學模型，還要熟知天下事、懂得思考人性與變量之間的關係。朱教授已於國際期刊發表近60篇具影響力的論文，並獲國際權威經濟書目數據庫IDEAS列為全球排名前10%的經濟學家，更在創新領域全球排名前70。

是甚麼驅使朱智豪教授走進經濟學的世界？1997年亞洲金融風暴嚴重衝擊多國經濟。那年在加拿大西蒙弗雷澤大學就讀的朱智豪和家人亦遭波及，經濟壓力頓增，卻也激發了他鑽研金融危機。他後來拜讀了2008年諾貝爾經濟學獎得主保羅・克魯曼（Paul Krugman）的名著《失靈的年代 — 克魯曼看蕭條經濟》。克魯曼在書中對亞洲金融風暴到來前的大膽預測引起他的興趣。不過，現代宏觀經濟模型假設蕭條由外生衝擊（如生產力、消費偏好、勞動供給等）引致，未能完整解釋金融危機的形成和預防，因此朱教授把目光轉向另一位諾貝爾經濟學獎得主保羅・羅莫（Paul Romer）的內生增長理論。

朱教授說:「這兩位諾貝爾獎得主的研究成果都令我有所啟發。我認為與其糾纏於難有結論的外生衝擊，倒不如探討內生增長理論。該理論指經濟能在不依賴外力的情況下持續增長，從而改善民生。內地開始改革開放後的經濟發展是一大例證。」

自強不息的求學歲月

朱智豪16歲時獨自從香港到加拿大求學。1997年，突如其來的亞洲金融風暴導致他的家境有變，逐漸面對經濟壓力，但他不單沒有意志消沉，反而更加珍惜得來不易的學習時光。為了繼續升學，他在大學時兼任家教，賺取學費和生活費，並在大學四年級因教學能力備受教授青睞，成為助教，每週在大學的「商業經濟學」和「管理科學」輔導小組執教。本科畢業後，朱智豪獲獎學金先後到加拿大英屬哥倫比亞大學和美國密歇根大學攻讀碩士和博士學位，期間一直擔任助教，積累教學經驗。

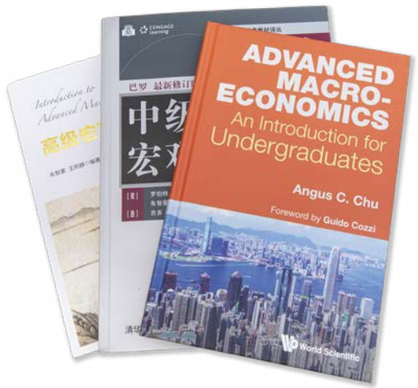
朱教授說：「回顧留學美加的生涯，我很慶幸遇上人生的幾位伯樂，他們都是我的恩師，給了我很多難得可貴的機會，深刻影響我的教學模式。如今我追隨他們的步伐，將經驗化為教學實踐。」

學習宏觀經濟的鑰匙

從研究方法看，經濟學與數學和統計學方法的運用密不可分。古典經濟學著作《國富論》和《賦稅論》背後都牽涉數學分析。朱教授直言，宏觀經濟學的入門課程大多僅要求學生掌握傳統的凱因斯模型，即把重心放在商品市場的需求面來探討市場均衡產出的多寡。該模型強調有效需求對國民所得的影響，常以圖形表達，較少數學運算，相對簡單易用；然而，要深入研究現代宏觀經濟學時，該模型就顯得有所不足。

朱教授解釋：「當前主流宏觀經濟學注重微觀基礎，通常要考慮個人行為對自己效用最大化的要素，運用複雜的動態一般均衡模型。我教學時會循序漸進，講解凱因斯模型等入門基礎理論後，就會講授靜態一般均衡模型，開始涉及較為複雜的數學分析，對本科生是有些難度。」他接著說：「再往深一層就是更為複雜的動態一般均衡模型的分析處理，要用上許多學生較少接觸的數學工具，相對深奧。不過，這是修讀碩士和博士課程必須掌握的學術能力，因此我們鼓勵學生在本科學習時就打好動態一般均衡模型的基礎。」

為使學生理解宏觀經濟學涉及的數學概念，朱教授著有《Advanced Macroeconomics: An Introduction for Undergraduates》（高級宏觀經濟學：本科生入門），並與海內外學者合作編著了《高級宏觀經濟學入門》和《Intermediate Macroeconomics》（中級宏觀經濟學）。這些著作分別獲World Scientific出版社、清華大學出版社及Cengage



朱智豪教授的學術著作
Academic books written by Prof Angus Chu

Learning出版社出版。這些書籍能加強學生對宏觀經濟學的微觀基礎內容的理解，並協助他們提升經濟學直覺、理解經濟學背後的數學公式和增強邏輯思維。

懷經世濟民之志

學術研究就是不斷開闊視野、站在前沿。朱教授很欣賞澳大榮譽博士、諾貝爾經濟學獎得主詹姆士·莫里斯（Sir James Mirrlees）教授苦心孤詣的精神。他在美國密歇根大學攻讀博士課程時曾接觸到莫里斯教授有關優化稅收的開創性理論，「莫里斯教授早在上世紀70年代提出如何為『異質性人群』設計一個最優的稅務系統，但宏觀經濟要到上世紀90年代才真正做到『異質性』，可見他的數學功力和學術視野遠超同儕。」

朱教授認為，經濟學家應先天下之憂而憂，以研究為社稷解困。他引述東晉時代葛洪在《抱朴子·內篇》中提出「經世濟俗」的概念，指出經濟學家需有經國濟民的胸懷：「經濟好壞直接影響每個人的生活，經濟學家可透過實事求是的研究，及時發現並解決經濟發展時的問題，協助政府制訂更好的經濟政策，提高經濟增長，從而改善大眾的生活質素和社會福利。」

研究創新驅動的經濟

在全球經濟格局變化、物聯網和人工智能崛起的今天，創新已是引領發展的首要動力。如何運用市場化機制激勵企業創新，全面提升企業創新能力，是朱教授近年主要的研究方向。他曾在英美加求學和教學近20年，2016年透過上海「千人計劃」到復旦大學任教。此後他致力研究內地的經濟增長，為內地實現創新型經濟增長提供理論支撐。2021年應聘到澳大後，他繼續研究創新驅動，尤其是與知識產權保護相關的政策，也為澳門發展高新科技帶來啟示。朱教授強調，隨著知識型經濟到來，亞當·史密斯提出的市場「無形之手」理論已經不合時宜。

朱教授解釋：「實證研究顯示，來自企業創新的私人回報率較社會回報率低幾倍，市場均衡的研發投資遠低於社會最優水平，原因是創新驅動的發展易受外部性的影響而導致市場失靈。因此，政府需要以政策支持形式干預和克服市場失衡。政府的政策支持也可加快科技成果的轉化和應用，促進科技創新與實體經濟深度融合。」

朱教授表示，國家早在「十一五」規劃時已提及研發創新的重要角色，而創新政策要與廣泛的產業政策聯繫起來。他又指出，企業家有動力創新，是因為想透過壟斷競爭成為創新大亨，這亦是保羅·羅莫的經濟研究的核心概念。「國家目前致力建設國際知識產權保護的高地，將為創新企業帶來更完善的法律保障。」

朱智豪教授鼓勵學生在本科學習階段打好動態一般均衡模型的基礎

Prof Angus Chu encourages undergraduate students to lay a firm foundation in dynamic general equilibrium modelling

Economics is the study of economic activities and patterns in human society. It is stated in *Inner Chapters of Baopuzi*, an ancient Chinese text written by Ge Hong from the Eastern Jin dynasty, that economists need to have the heart to 'serve their nations and help their people'. Angus Chu, a distinguished professor at the University of Macau (UM) and head of UM's Department of Economics, shares the same belief. As a student, he encountered the Asian financial crisis, which sparked his interest in financial crises. Today, as an accomplished economist ranked among the top 10 per cent in the world, Prof Chu aspires to build a better world. He believes that an economist's job is to anticipate problems that may arise in society and address these problems through research.

A Spark of Interest in Financial Crises

At its roots, economics is a discipline that explores economic activities and patterns in human society. In the 21st century, its influence continues to increase in social sciences, with people's subjective consciousness and behaviour included in its sphere of study, and with economic analysis widely applied in areas such as business, finance, and public administration. According to Prof Chu, when studying economic issues, apart from solid theoretical knowledge and mathematical models, one should also have a good understanding of the world in order to analyse the relationships between human nature and external variables. So far, Prof Chu has published nearly 60 influential papers in prestigious international journals. He is ranked among the top 10 per cent of economists by IDEAS, an authoritative international database for economics publications, with a global ranking of top 70 in innovation.

What propelled Prof Chu to study economics? He explains that it was a result of the Asian financial crisis in 1997. At that time, the economies of many countries were hit hard. As a student at Simon Fraser University in Canada, Chu and his family were not immune to the impact of the crisis and were under immediate financial pressure, but it was also this experience that inspired him to study financial crises. Later on, he read *The Return of Depression Economics*, a book written by the 2008 Nobel laureate in economics Paul Krugman, and became intrigued by Krugman's bold predictions of the Asian financial crisis before its arrival. However, modern macroeconomic models assume that depressions are caused by exogenous shocks (such as productivity, consumer preferences, and labour supply) and cannot fully explain the formation and prevention of financial crises. To gain a different point of view, Prof Chu began to study the work of another Nobel laureate in economics, namely Paul Romer's endogenous growth theory.

'The research works of Paul Krugman gave me an initial understanding of the causes of financial crises. In my opinion, rather than dwelling on exogenous shocks whose effects on financial crises are difficult to conclude, it is better to explore the theory of endogenous growth, that is, the ability of an economy to grow sustainably without relying on external forces to improve people's livelihoods,' says Prof Chu. 'The economic development of mainland China after its economic reform is a good example.'

A Driven College Student

Just as there are ups and downs in economic development, Prof Chu's life as a student was never smooth sailing. At the age of 16, Chu moved to Canada from Hong Kong alone to pursue further studies. In 1997, the sudden Asian financial crisis caused a change in his family's circumstances and put financial pressure on his life. Instead of feeling disheartened by this twist of fate, Chu valued his learning opportunities even more. In order to support himself through undergraduate studies, he worked as a part-time tutor. In his fourth year at university, he was selected by his professors to be a teaching assistant, teaching weekly in the university's business economics and management science tutorials. After graduation, Chu obtained scholarships for his master's studies at the University of British Columbia in Canada and later for his PhD studies at the University of Michigan in the United States. He also worked as a teaching assistant during both periods, garnering hands-on experience that would later prove invaluable in his teaching career.

'Looking back on my time as a student in Canada and the United States, I feel very fortunate to have met several important mentors,' says Prof Chu. 'They opened up many opportunities for me and have had a profound influence on my teaching style. I am simply following in their footsteps to impart my knowledge to students.'

Key to Studying Macroeconomics

From the perspective of research methodology, it is nearly impossible to study economics without mathematics and statistics. For example, economic theories developed by authors of classics such as *The Wealth of Nations* and *A Treatise of Taxes and Contribution* can be presented as mathematical analyses. According to Prof Chu, introductory courses in macroeconomics only require students to master the typical Keynesian model, which focuses on the demand side of the goods market when examining the amount of equilibrium output on the market. He adds that the model emphasises the impact of effective demand on national income and is relatively easy to use because of its graphical nature. Nevertheless, this model may not be sufficient when one wants to go deeper into contemporary macroeconomics.

Studies of macroeconomics today mainly focus on micro-foundations, often taking into account how individual behaviour maximises one's own utility with the use of complex dynamic general equilibrium models,' says Prof Chu. 'I would gradually increase difficulty level when teaching students. For example, I would teach introductory theories first, such as the Keynesian model, before moving on to more difficult topics such as static general equilibrium modelling that involves complex mathematical analyses. They are somewhat difficult for undergraduate students.' In Prof Chu's class, further down the road students will need to study dynamic general equilibrium modelling and learn how to analyse these complex models with mathematical tools that are less common. The mathematical tools involved will be more difficult, but they must be mastered if students were to study for a master's or PhD degree. 'It is for this reason that we encourage students to lay a firm foundation in dynamic general equilibrium modelling during undergraduate studies,' says Prof Chu.

朱智豪教授獲國際權威的經濟書目數據庫IDEAS列為全球前10%經濟學家

Prof Angus Chu is ranked among the top 10 per cent of economists by IDEAS, an authoritative international database for economics publications

To make the math concepts in macroeconomics easier to digest for students, Prof Chu has written *Advanced Macroeconomics: An Introduction for Undergraduates*. He has also worked with scholars both in China and abroad in the writing of *Introduction to Advanced Macroeconomics* and *Intermediate Macroeconomics*. Published by World Scientific Publishing, Tsinghua University Press, and Cengage Learning, respectively, the books aim to increase students' understanding of micro-foundations in macroeconomics and to improve their ability to think logically and intuitively about economic concepts that are based on math.

Aspiring to Build a Better World and Help People

Research is fundamental in pushing the frontier of fundamental knowledge even further. In his quest for new knowledge, during his PhD studies at the University of Michigan Prof Chu studied the pioneering theory of optimal taxation proposed by Sir James Mirrlees, a Nobel laureate in economics and an honorary doctor of UM. Mirrlees developed the theory in the 1970s, but it was so ahead of its time that Prof Chu became an admirer of Mirrless. 'Sir Mirrlees proposed how to design an optimal tax system for a "heterogeneous population" in the 1970s, while macroeconomics did not embrace models with heterogeneous agents until the 1990s,' says Prof Chu. 'His profound mathematical skills and vision were far ahead of his peers.'

According to Prof Chu, economists are expected to think ahead and anticipate problems of society before they arise. He quotes *Inner Chapters of Baopuzi*, a book written in ancient China, to explain the responsibilities of economists: 'Economy has a direct impact on people's lives. Through pragmatic research, economists can identify and solve problems

如何運用市場化機制激勵企業創新是朱智豪教授近年的研究方向

In recent years Prof Angus Chu has been studying how to use the market mechanism to encourage innovations in enterprises

arising in the process of economic development in a timely manner. In this way, they can help governments create better economic policies to promote economic growth and to improve people's quality of life and the social welfare system.'

An Economy Driven by Research and Innovation

As a result of recent changes in the global economic landscape and the emergence of new technologies such as the internet of things and artificial intelligence, innovation has become the major driver of economic development. Prof Chu has been studying how to use the market mechanism to encourage innovations in enterprises. He studied and taught for nearly 20 years in the United Kingdom, the United States, and Canada. In 2016, he returned to China through the Overseas High-Level Talent Recruitment Programme (The Thousand Talents Plan) of Shanghai and became a professor at Fudan University. The position allowed him to conduct studies on China's economic growth to provide theoretical support for the country's goal of achieving innovation-driven economic growth. After joining UM in 2021, he continued to study this topic, focusing on policies for intellectual property protection, in order to create meaningful changes for the development of the hi-tech industry in Macao. He believes that the advent of a knowledge-based economy means the invisible hand, an economic concept proposed by Adam Smith, is no longer relevant.

'Empirical studies have shown that since the private rate of return on corporate innovation is several times lower than the social rate of return, the market level of investment in R&D is much lower than the social optimum,' says Prof Chu. 'This is because innovation-driven development is susceptible to externalities that lead to market failures and therefore requires government intervention in the form of policy support to overcome market imbalances. Policy support from the government can also speed up the commercialisation of research results and promote deeper integration of technological innovation with the real economy.'

According to Prof Chu, China began highlighting the importance of research, development, and innovation in the 11th Five-Year Development Plan. He points out that an alignment of innovation policy and the broader industrial policy would create favourable conditions for R&D and innovation, adding that entrepreneurs are motivated to innovate because they want to become innovation moguls to monopolise the market — a concept at the heart of Paul Romer's economic research. 'China is now committed to becoming an international centre for intellectual property protection, which will bring better legal protection to innovative enterprises.' says Prof Chu.

盧杰：教學就是說一個好故事

Jeremy De Chavez: Teaching is Telling a Good Story

文/盛惠怡、資深校園記者林霞遠．圖/何杰平、校園記者林程峰、編輯部，部分由受訪者提供
Chinese & English / Debby Seng, Senior UM Reporter Charlotte Lin．
Photo / Jack Ho, UM Reporter Victor Lam, Editorial Board, with some provided by the interviewee

澳門大學英文系助理教授盧杰（Jeremy De Chavez）的學生很可能都會對他上課時演奏中提琴的畫面印象深刻。盧教授設法將課本知識轉化為聲音和影像，使學生更易理解。他說：「教學就是說一個好的故事，只要引起學生的好奇心，他們就會樂此不疲地鑽研下去。」

從小鍛煉說故事的能力

盧教授在菲律賓馬尼拉長大。菲律賓自16世紀先後成為西班牙和美國的殖民地，二戰時曾被日本佔領，所以他一出生就受殖民文化影響。「我的姓氏『De Chavez』是西班牙語，名字『Jeremy』是很常見的美國人名。我的姓名是殖民主義在菲律賓的產物。」

盧杰年輕時常用英語與朋友交談，也會一起欣賞美國電影和流行音樂，「由於英語在流行文化的普及，當時我和朋友都認為說英語是一個潮流。」熱愛英語的盧杰開始愛上英語文學，尤其是愛倫．坡等作家的著作，特別是其小說《亞瑟．戈登．皮姆的故事》。

盧杰讀中學時，常常在下課後等車回家時看英語小說。他的英文老師Salve Regalado見他喜愛閱讀，經常午後找盧杰介紹書中內容。盧杰小時候以為Regalado老師純粹想和他聊天，長大後才發現老師用心良苦：「我向老師分享故事時會觀察她的表情，當我感到她不太感興趣時，就會講快些或直接跳到精彩的情節。我也會調整語調，當老師看來興致勃勃時，我會多花心思敘述她感興趣的地方，讓她聽得更津津有味。其實，我那時就是在學習講好一個故事。」

盧杰受Regalado老師啟發立志從教。他於菲律賓大學修讀英國文學，其後往新加坡國立大學讀碩士，再到加拿大皇后大學攻讀博士，畢業後曾在加拿大皇后大學及威爾弗里德．勞雷爾大學任教。他後來回到菲律賓，在德拉薩爾大學任教，2018年加入澳大英文系。

卓越教學獲認可

盧教授嘗試用多種教學方法令學生更投入和享受學習。「我努力把課室變成一個接納好奇心的地方。我也建議人文學科的教育者努力提升學生對課程的興趣。」憑著傑出的教學表現，盧教授獲大學頒發2020/2021學年卓越教學獎，他得悉獲獎時既驚又喜：「這個獎讓我感到澳大非常重視人文社科的價值。」

英文系的課程聚焦於英語在文學、語言和跨文化交流中作為全球媒介的歷史作用和當下的角色。盧教授說：「我們幫助學生提升英語能力，也注重培養創造性思考和反思性思維等素養，使學生得以面對目前和未來的挑戰，不斷探索自我。」

鼓勵學生發揮好奇心

「如要用一個詞來概括我的教學理念，那必定是『好奇心』。」盧教授的學生都能感到他對教學抱有極大熱誠。他授課時抑揚頓挫，有如講述生動有趣的故事，吸引學生聽課。他說：「我常常思考如何將講故事的技巧融入到教案，確保課程能激發學生的好奇心和使他們專注。」

盧教授認為，好奇心在學習過程中十分重要，這源於他自身的經歷。1993年電影《侏羅紀公園》上映時，他只有十多歲，被電影裡的恐龍深深吸引，放學後時常到圖書館翻閱與恐龍有關的書籍。「電影啟發了我對恐龍的熱情。我對與恐龍有關的事都十分好奇。好奇心推動我不斷學習。」

在盧教授小時候，父母鼓勵他學中文，於是他修讀了一個中文課程，老師以其英文名諧音為他取了中文名「盧杰」。當時他覺得中文十分難學，沒多久就放棄學習。他來到澳門後，日常不時接觸到中文，使他決心到澳大孔子學院學中文。他在2019/2020年度孔子學院的畢業禮上朗誦了李白的《將進酒》。好奇心引領盧教授進入中國文學的世界，他這股學習精神也影響了學生。

澳大校長宋永華教授（右）向盧杰教授頒授「澳門大學卓越教學獎」
UM Rector Yonghua Song (right) presents the University of Macau Teaching Excellence Award to Prof Jeremy De Chavez

盧杰教授演奏中提琴

Prof Jeremy De Chavez plays a viola

2018年盧杰教授首次到澳大時於圖書館前留影

Prof Jeremy De Chavez in front of the UM library during his first visit to the university in 2018

情感理論與全球英語文學

盧教授的研究及教學以情感理論、後殖民研究、全球英語文學、批判／文化理論為主。他認為情感在文學研究扮演重要角色：「一些文學評論者曾認為，讀者對作品的感受與如何闡釋作品無關。他們相信情感對文學解釋無足輕重，甚至會帶來阻礙，這種觀點常被稱為『感受謬見』。相反，情感理論挑戰這觀點，主張情感在文學研究佔有十分重要的角色。」

盧教授研究的文學作品大多出自後殖民地時期的作家，內容圍繞殖民主義如何改變他們國家的文化面貌、經濟和政治。情感理論者面對這些作品時，主要研究當中的憤怒、恐懼、抑鬱等負面情感。他的新作《正向影響及後殖民評論》則聚焦正面情感，因為他認為積極的情感對於想像未來的可能性也是至關重要。

除了情感理論，盧教授也致力研究菲律賓哥德式文學。他很慶幸在澳大得到很多造詣精湛的學者指導。「我相信澳大是全球研究哥德式文學最佳的地方之一。大學在這個領域匯聚了很多優秀學者，包括Bill Hughes、Matthew Gibson、Nick Groom和Damian Shaw等教授。在他們指導下，我相信自己可以在菲律賓哥德式文學領域成為更成功的學者。」受這些同僚啟發，盧教授正在編輯《Archipelagothic: Studies in the Philippine Gothic》，這將會是首本關於菲律賓哥德式文學的專著，預計2022年9月出版。

以音樂拓展學生思維

盧教授主要任教本科課程「文學批評導論」及研究生課程「批判性閱讀」。他講授英文詩時，有時會以音樂為輔助，例如在課室演奏中提琴。「聽音樂時，我們瞬間就知道自己喜不喜歡樂曲，可見音樂是最易『入口』的藝術方式之一。不同類型的藝術能互相闡述，所以我嘗試以音樂連結文學。」

盧教授還講授通識課程「言辭與創意：面向國際讀者的英文寫作」和「性與藝術」。他曾在「性與藝術」的一節課演奏一段巴赫的《G大調第一號無伴奏大提琴組曲》（薩拉班德），請學生嘗試理解樂章中抒發的情感，「我希望以藝術引領學生學習跳出傳統思維的框架。」

If you have attended the courses of Jeremy De Chavez, assistant professor of the Department of English at the University of Macau (UM), you may be impressed by hearing him play his viola in class. Prof De Chavez is good at using audio and visual aids to help students engage more deeply with course content. Prof De Chavez says, 'Teaching is telling a good story. If you can arouse wonder in students, it will cultivate a desire to learn.'

Developing Storytelling Skills from an Early Age

Growing up in Manila, the Philippines, a colony of Spain and then the United States since the 16th century, and occupied by Japan during World War II, Prof De Chavez was influenced by the country's colonial culture. 'My surname "De Chavez" is Spanish while my first name "Jeremy" is a rather common American name,' he says. 'My name is marked by the colonial legacy of the Philippines,' says Prof De Chavez.

When De Chavez was young, he spoke English with his friends, and they watched American movies and listened to American pop music together. 'My friends and I thought it was "cool" to speak English since it was so pervasive in the popular culture of the time,' he says. The love for the language led him to fall in love with English literature. He admired the works of authors such as Edgar Allan Poe, especially liking his novel *The Narrative of Arthur Gordon Pym of Nantucket*.

In high school, De Chavez often read English novels as he waited for his ride home from school. His English teacher, Ms Salve Regalado, noticed that and started regular afternoon chats with De Chavez about the books he was reading. At that time, De Chavez thought Ms Regalado just wanted to talk with him. Later, he realised her good intentions. 'When I shared stories with Ms Regalado, I would observe her expression. When I noticed her interest waning, I would speed up the pace or just skip to the exciting parts. I would also adjust my tone. When she looked interested, I would try to amplify her interest. In other words, I was learning how to tell a story,' he says.

Inspired by Ms Regalado, De Chavez decided to become a teacher. He studied English literature at the University of the Philippines and completed his master's degree at the National University of

盧杰教授在2019/2020年度澳大孔子學院畢業禮朗誦李白的《將進酒》

Prof Jeremy De Chavez recites Li Bai's *Do Drink Wine* at the graduation ceremony of the UM Confucius Institute for the 2019/2020 academic year

Singapore. After graduating with a PhD degree from Queen's University in Canada, De Chavez taught at Queen's University and Wilfrid Laurier University in Canada for some time before returning to the Philippines to teach at De La Salle University. In 2018, he joined the Department of English at UM.

Excellent Teaching Recognised by Students

I strive to turn the classroom into a place hospitable to wonder,' Prof De Chavez explains. 'In saying this, I am also suggesting that educators in the humanities should be in the business of enchantment.' He tries different teaching methods to make the learning process more engaging and enjoyable. In recognition of his outstanding teaching performance, Prof De Chavez received the Teaching Excellence Award for the 2020/2021 academic year from UM. When he learned that he won the award, he was both surprised and delighted. He says, 'Receiving this award makes me feel that UM really values education in the humanities and social sciences.'

The programmes offered by the Department of English focus on the historical and contemporary role of English as a global medium in literature, language, and intercultural communication. 'We help our students develop proficiency in the English language as we also cultivate their creative and critical thinking skills, so that they can meet the challenges in this fast-changing world,' Prof De Chavez says.

Encouraging Students to Be Curious

'If I could sum up my teaching philosophy in one word, that word would be "wonder"', says Prof De Chavez. Students who have attended his classes said that they could feel his passion for teaching. For example, he always speaks in a dynamic and engaging tone, the way a good storyteller does. Prof De Chavez says: 'I would always think about how to weave storytelling into my lesson plan in order to secure the attention of my students and arouse their curiosity.'

Prof De Chavez's belief in the importance of wonder in the learning process stems from his own experience. When the film *Jurassic Park* was released in 1993, De Chavez, then a young boy and a dinosaur fanatic, was immediately captivated. He devoured all the dinosaur-related books in the library after school. 'The movie inspired my passion for dinosaurs and I was very curious about everything related to them,' he says. 'It was wonder and curiosity that keep me learning.'

盧杰教授在「澳門大學卓越教學獎」講座分享教學心得

Prof Jeremy De Chavez shares his teaching experience at the University of Macau Teaching Excellence Award Seminar

The parents of De Chavez encouraged him to learn Chinese when he was young. He enrolled in a Chinese language course and his teacher gave him a Chinese name 'Lu Jie', which was based on his English name. However, he found Chinese very difficult to learn, so he gave up after a short time. After coming to Macao, however, he realised that he needed to be able to speak at least a little Chinese in his daily life, which rekindled his interest in learning the language. So he enrolled in a Mandarin course offered by the UM Confucius Institute in the 2019/2020 academic year. By the time he completed the course, Prof De Chavez's Chinese had improved greatly. At the graduation ceremony, he was able to recite Li Bai's *Do Drink Wine* fluently. Prof De Chavez's curiosity led him into the world of Chinese literature, and his motivation to learn has had an impact on his students.

Affect Theory and Global Anglophone Literature

Prof De Chavez's research and teaching areas include affect studies, post-colonial studies, global Anglophone literature, and critical/cultural theory. He believes that affects plays an important role in literary studies. 'There was a period in the history of literary criticism when a group of critics thought that how one felt towards a particular work had nothing to do with its legitimate or valid interpretation; that is to say, feelings and emotions are inconsequential, even detrimental, to literary interpretation—this idea usually goes by the name "affective fallacy". Affect theory challenges this idea and argues for the importance of affects, emotions, and feelings,' he explains.

Prof De Chavez primarily studies works penned by post-colonial writers, and they often discuss how colonialism completely altered the cultural landscape of their country, its economy, and its politics. Prof De Chavez explains that the affect theorists who study those works overwhelmingly focus on negative affects and emotions, such as anger, fear, melancholia, and depression. His forthcoming book, *Positive Affects and Postcolonial Critique*, attends instead to positive affects and emotions. 'Positive affects and emotions are also essential in imagining alternative futures,' says Prof De Chavez.

In addition to affect theory, Prof De Chavez also recently turned to the study of Gothic literature in the Philippines. He feels fortunate to be mentored by many outstanding scholars in the field who work at the university. 'I believe UM is one of the best places in the world to study Gothic Literature,' he says. 'Many excellent scholars of the Gothic like Bill Hughes, Matthew Gibson, Nick Groom, and Damian Shaw are here! So, I can get the mentorship that I need to be a successful scholar in this field.' Inspired by these colleagues, Prof De Chavez is editing a book on Philippine Gothic literature, *Archipelagothic: Studies in the Philippine Gothic*, which is the first book on this topic. It will be published in September 2022.

Expanding Students' Minds with Music

Prof De Chavez currently teaches an undergraduate course, 'Introduction to Literary Criticism', and a postgraduate course, 'Critical Reading'. When he teaches English poetry-related content, he sometimes brings his viola to the classroom and uses music to elaborate on an idea. 'When we listen to music, we know instantly whether we like it or not, so music is one of the most "accessible" forms of art,' he says. 'Different art forms can be placed in conversation with each other, so I try to use music to teach literature.'

Prof De Chavez also teaches two general education courses, namely 'Creativity and Writing: English for a Global Readership' and 'Sex and the Arts'. He has played a piece of Bach's Cello Suite No 1 in G major (Sarabande) in one of his 'Sex and the Arts' classes to help his students get closer to the arts and feel the emotions expressed through the music. 'To think outside the Bachs (box), that's what I would like my students to learn,' he explains.

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SARS-CoV-2的Delta突變株為何傳染性如此之強？

Why Is the SARS-CoV-2 Delta Strain So Contagious?

文 / Siddharth Sinha、譚樂謙、王山鳴・圖 / 編輯部，部分由作者提供
Chinese & English / Siddharth Sinha, Benjamin Tam, San Ming Wang・Photo / Editorial Board, with some provided by the authors

新型冠狀病毒肺炎（COVID-19）疫情自2019年底起對全球公共衛生造成災難性後果，截止2022年1月已有逾3.18億人染疫、逾550萬人喪生。新冠肺炎是由嚴重急性呼吸系統綜合症冠狀病毒2（SARS-CoV-2）病毒感染所致。該病毒通過其刺突（S）蛋白上的「受體結合域」（RBD）與人體細胞表面的「血管緊張素轉換酶2」（ACE2）受體結合，感染人體細胞。因此，RBD是SARS-CoV-2感染人類的關鍵因素之一。SARS-CoV-2病毒基因組不斷發生突變，RBD部分也不斷產生新的突變。

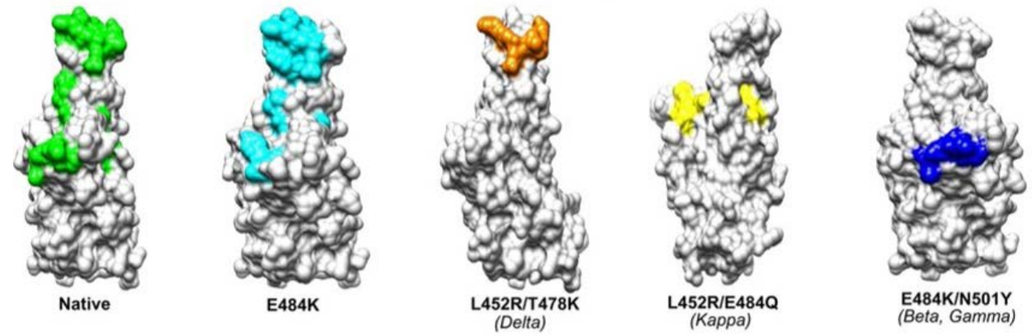
借助澳大超算設備分析

雖然大多數突變沒有引起致病問題，但一部分突變為病毒提供了生存優勢，因此被進化選擇出來。例如，RBD區域中包含了L452R、T478K、E484K、E484Q和N501Y單突變的SARS-CoV-2病毒株。它比沒有突變的更具傳染性，導致全球多次爆發區域性疫情，其後多個帶有RBD「雙突變」的新SARS-CoV-2突變株相繼出現。這些病毒株包含了上述兩個單突變。這些具有RBD雙突變的SARS-CoV-2病毒株比RBD單突變的SARS-CoV-2病毒株更具傳染性，引起多次更為嚴重的全球性大爆發，對未接種疫苗的人群帶來高風險。以典型的RBD雙突變SARS-CoV-2突變株「Delta」為例，Delta突變株含有RBD雙突變L452R和T478K。Delta突變株比之前幾乎所有SARS-CoV-2病毒株都更具感染性。Delta突變株從2020年底在印度被發現起，迅速在全球傳播，影響極為嚴重。

為控制SARS-CoV-2病毒在全球蔓延和開發有效的治療方法，我們急需揭開RBD突變令SARS-CoV-2病毒傳播能力增加的機制。有科學家認為，RBD突變所致的SARS-CoV-2病毒傳播能力的增加，可能與突變導致病毒RBD與人類ACE2受體發生更為緊密的結合有關，但這種說法缺乏強而有力的直接證據。為了研究這個問題，我們分析突變RBD和人類ACE2受體之間蛋白結構的相互關係。借助澳門大學資訊及通訊科技部的超級計算機，我們採用野生型作為對照，比較了包括L452R、T478K、E484K、E484Q和N501Y單突變RBD和包括L452R/T478K（Delta）、L452R/E484Q（Kappa）和E484K/N501Y（Beta, Gamma）的雙突變RBD對RBD與ACE2受體關係的影響，方法包括採用分子動力學模擬來測量RBD突變體結構的熱動力學變化、採用疊加結構對比方法以圖像呈現由突變引起的RBD結構改變、檢測自由結合能的變化，從而確定突變對RBD和ACE2受體之間蛋白親和力的影響，還有測試由突變引起的RBD表面結構變化與中和抗體結合位點的改變等。

研究結果獲世衛納入指南

我們的研究提供的系統化數據表明，RBD單突變改變了RBD和ACE2受體之間的結構關係，而相比單突變的改變，RBD雙突變導致的RBD和ACE2受體之間的結構關係發生了更為不同的改變，導致雙突變RBD與ACE2受體之間的結合力大為增強。RBD上的抗體結合位點發生極大改變導致抗體結合能力降低。因此，雙突變RBD大大增加了SARS-CoV-2對人類細胞的傳染性。我們的研究成果很快被《病毒》期刊接納發表（https://doi.org/10.3390/v14010001），更獲世界衛生組織立即納入其2021年《COVID-19臨床管理生活指南》（https://www.who.int/publications/i/item/WHO-2019-nCoV-clinical-2021-2），作為解釋雙突變RBD導致SARS-CoV-2高度傳染性的依據。



本圖顯示突變的 RBD 降低了抗體的結合力，不同顏色代表 RBD 中的抗體位結合部位：綠色是非突變RBD、淺藍色是RBD 單突變 E484、洋紅色是RBD 雙突變 L452R/T478K、黃色是 RBD 雙突變L452R/E484Q，藍色則是RBD 雙突變E484K/N501Y。

This figure shows that mutated RBD decreases an antibody's binding capacity. The antibody sites in the RBD are highlighted in different colours. Green: Native RBD; light blue: RBD single mutant E484K; magenta: RBD double mutant L452R/T478K; yellow: RBD double mutant L452R/E484Q; blue: RBD double mutant E484K/N501Y.

新突變株Omicron

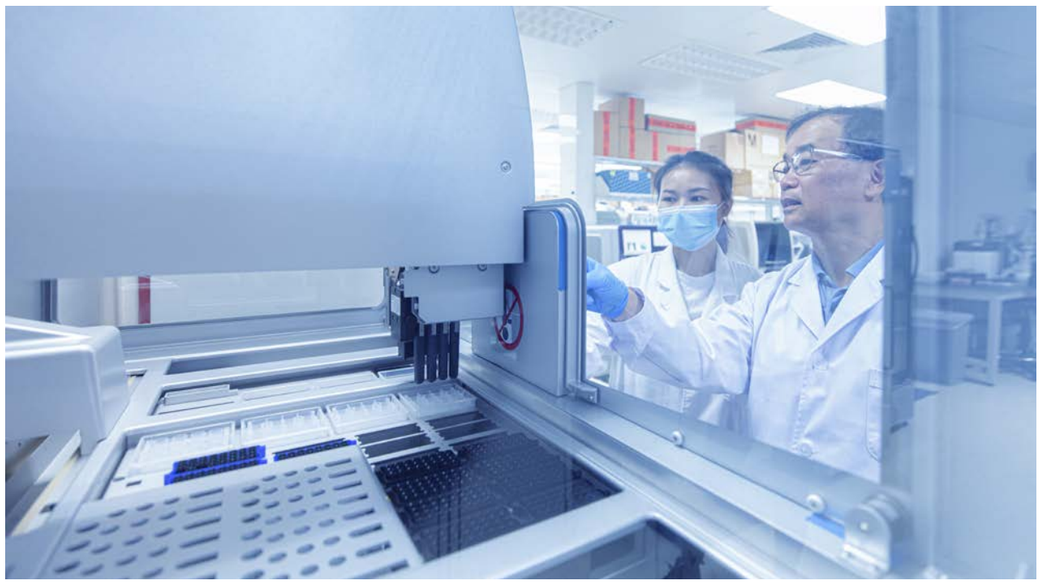
在南非首次出現、名為奧密克戎（Omicron）的SARS-CoV-2突變株迅速在全球傳播，取代了Delta成為目前主要的SARS-CoV-2突變株。Omicron突變株有18個RBD突變，其中4個（L452R、Y478K、E484K、N501Y）與單突變和雙突變株相同。正如從單突變RBD到雙突變RBD導致SARS-CoV-2傳染性增加一樣，這4個RBD雙突變與Omicron中的14個新RBD突變的組合，或許也是導致SARS-CoV-2傳染性劇增的主因之一。新近產生的Deltacron突變株由Delta突變株和Omicron突變株雜交而成，提示我們RBD突變對新的SARS-CoV-2突變株感染力的變化同樣可能起重要作用。我們對RBD雙突變的研究結果，直接有助了解這些「經典」和新產生的RBD新突變導致的SARS-CoV-2流行，並為開發阻止SARS-CoV-2傳播的方法提供一個理論基礎。

本研究獲澳門科技發展基金、澳門大學、澳大健康科學學院和澳大濠江人才計劃支持。

The COVID-19 pandemic has had a devastating impact on global public health since late 2019. As of January 2022, the SARS-CoV-2 virus, which causes a symptom of pneumonia, has infected over 318 million, and killed over 5.5 million people. SARS-CoV-2 infects human cells through the 'receptor-binding domain' (RBD) on its spike (S) protein to the 'angiotensin-converting enzyme 2' (ACE2) receptor on the human cell surface. Therefore, RBD is a key determinant of SARS-CoV-2 infection in humans. SARS-CoV-2 is rapidly evolving, with new mutations constantly generated across its genome, including the RBD.

Analysis with Supercomputing Cluster in UM

While most mutations did not survive evolutionary selection, some of them provide a survival advantage for the virus. This is the case for the variant strains with mutations of L452R, T478K, E484K, E484Q, and N501Y in the RBD domain, which have caused several outbreaks due to the increased infectiousness of SARS-CoV-2 with these RBD mutations. Later, several new SARS-CoV-2 strains with RBD 'double mutations' began to emerge. These strains contain two of the single mutations mentioned above. They are more contagious than the strains with a single



王山鳴教授（右）致力研究癌症遺傳和預防
Prof San Ming Wang (right) specialises in cancer genetics and prevention

RBD mutation and have caused multiple outbreaks worldwide that have been more severe than those caused by the strains with a single mutation, putting unvaccinated populations in particular at high risk. Take the example of the Delta strain, which was first identified in India in October 2020. The strain contains a double RBD mutation L452R/T478K and is much more contagious than previous mutant strains in terms of severity of infections and hospitalisation rates. The Delta strain spread rapidly throughout the world and became the predominant strain of SARS-CoV-2.

To control the SARS-CoV-2 pandemic and develop better treatments, there is an urgent need to uncover the mechanism of increased transmissibility due to RBD mutations. It is suspected that the increased transmissibility of SARS-CoV-2 caused by RBD mutations may be related to the mutations causing stronger binding of the viral RBD to the human ACE2 receptor. However, clear evidence for this assumption is lacking. In our study, we investigated whether an increased RBD mutation could cause a structural change leading to a tighter binding between RBD and the human ACE2 receptor. We compared the effects of single mutations in RBD, including L452R, T478K, E484K, E484Q, and N501Y, with double mutations, including L452R/T478K (Delta), L452R/E484Q (Kappa), and E484K/N501Y (Beta, Gamma) on the relationship between RBD and ACE2 receptors, using the wild type as a control. Using the supercomputing cluster in UM's Information and Communication Technology Office, we analysed single and double RBD mutations by using molecular dynamics simulations to measure the thermodynamic changes in the structure of the RBD mutants. We also visualised the mutation-induced changes in the RBD structure with superimposed structural comparisons, investigated the changes in free binding energy to determine the effect of mutations on the protein affinity between RBD and the ACE2 receptor, and tested the mutation-induced changes in the RBD surface structure and the neutralizing antibody binding sites.

Research Results Included in WHO COVID-19 Guidelines

The results of our research show that double mutations have altered the structure of RBD in ways very different from those by single mutations: Double mutations have increased the binding strength between the RBD and the ACE2 receptor, altered antibody binding sites on the RBD, and reduced the effectiveness of neutralising antibody. Therefore, RBD double mutations directly contribute to the increased contagiousness of SARS-CoV-2 to the host cells through their increased binding to the ACE2 receptor. Our study was quickly accepted and published by the scientific journal *Viruses* (https://doi.org/10.3390/v14010001). It was also immediately cited by the World Health Organization in its 'Living guidance for Clinical Management of COVID-19' (https://www.who.int/publications/i/item/WHO-2019-nCoV-clinical-2021-2), published in 2021, to explain the high infectivity of RBD double mutations.

Omicron Mutant Strain

The Omicron mutant strain, discovered in South Africa, has recently replaced the Delta variant as the dominant strain in most parts of the world. There are 18 RBD mutations in Omicron, four of which (L452R, Y478K, E484K, N501Y) are the same as in the single and double mutant strains. Similar to the increased contagiousness from single mutations to double mutations, the combination of four RBD double mutations with the 14 new RBD mutations in Omicron is likely to cause a further increased contagiousness of SARS-CoV-2. The latest Deltacron variant, which is a hybrid between the Delta mutant and the Omicron mutant, suggests that the RBD mutation may continue to play important roles in the contagiousness of the new SARS-CoV-2 variants. The results of our study on single and double RBD mutations have direct implications for understanding the role of these 'typical' RBD mutations and the new Omicron-specific RBD mutations in the rapid spread of the virus, as well as for developing new approaches to prevent their global spread.

The study was supported by the Science and Technology Development Fund of Macao, the University of Macau (UM), the Faculty of Health Sciences (FHS) of UM, and the UM Macao Talent Programme.

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「學術研究」為投稿欄目，內容僅代表作者個人意見。
Articles in the Academic Research column were submitted by UM scholars. The views expressed are solely those of the author(s).

運用人工智能從中藥篩選潛在的老人癡呆藥物

Using AI Technology to Develop TCM-based Drugs for Alzheimer's Disease

文、圖 / 莊旭旭、路嘉宏．英文翻譯 / 蘇恩霆
Chinese and Photo / Zhuang Xuxu, Lu Jiahong．English Translation / Anthony Sou

根據2020年發表的一項全國性橫斷面研究，中國60歲及以上長者的癡呆患病率為6%，其中阿爾茨海默病（英文：Alzheimer's disease，簡稱AD）佔3.9%。換言之，中國有1,507萬60歲及以上的癡呆症患者，其中983萬人是AD患者。隨著中國老齡化加劇，AD帶來的社會和經濟負擔將持續增加。儘管AD發病率不斷攀升，其藥物研發卻深陷困境。2000年到2017年間，多家藥企為AD藥物的研發投資了逾6,000億美元，但由於AD的具體病理機制尚未探明，這些研發項目大多失敗告終。

線粒體自噬：治療阿爾茨海默病的新策略

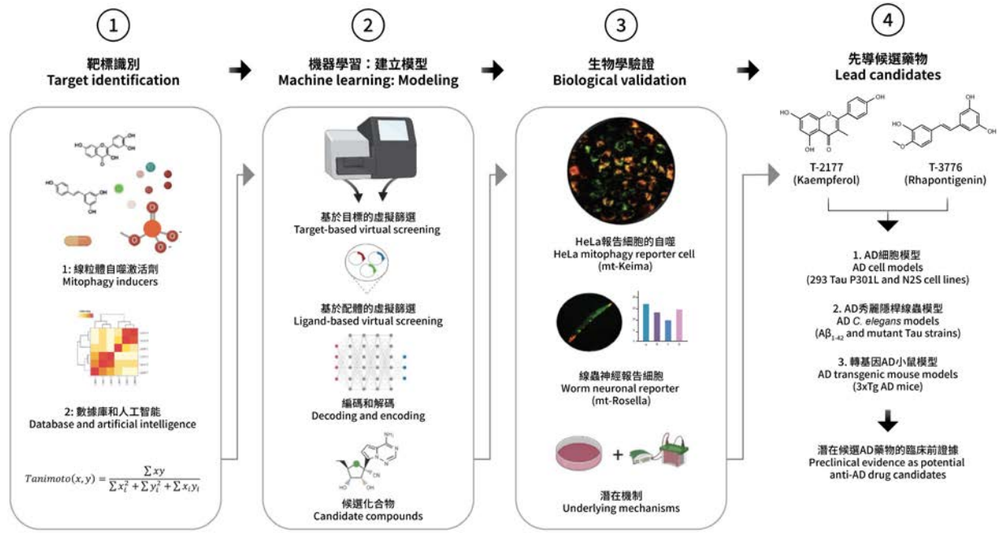
在神經細胞的老化過程中，線粒體作為細胞內的「發電廠」，不斷累積損傷並加劇神經細胞死亡。為了確保線粒體處於良好狀態，細胞通過一個精巧的品質控制系統——線粒體自噬，選擇性地清除細胞內衰老和受損的線粒體，從而維持神經細胞的健康。我們在前期研究發現，線粒體清除機制受損在阿爾茨海默症發病過程中扮演關鍵角色，而增強線粒體自噬功能可以改善AD動物模型的病理表現，可望成為治療AD的新策略。

然而，目前線粒體自噬激活劑稀少，安全的線粒體自噬激活劑尤其罕見，亟待更高效的激活劑發現方案和更安全的候選藥物資源庫。我們在澳門大學的課題組為此與挪威奧斯陸大學和杭州德睿智藥科技有限公司合作，開發了一種基於人工智能、融合多維分子資訊的虛擬篩選算法，並結合細胞、線蟲、小鼠作多物種的AD模型驗證，成功篩選出具有治療潛力的中藥小分子化合物。

人工智能助力發現線粒體自噬激活劑

我們的課題組多年來致力於從中藥提取天然小分子作為自噬調控劑和開展相關的藥理活性研究，並建立了包含生物鹼、黃酮、萜類等多類型化合物的天然小分子庫。這項涉及多方的國際合作項目引入了機器學習方案，對來自ChEMBL和ZINC這兩個數據庫的共1,900萬個小分子數據作預訓練。由此開發出來的表徵模型綜合考慮了分子各個維度的資訊，包括一維的序列資訊（SMILES），二維的分子拓撲相似性和三維的空間信息。基於從預訓練模型獲得的向量，研究團隊對我們課題組的天然小分子化合物庫中共3,724個天然小分子和14個已知的線粒體自噬誘導劑作聚類與過濾，篩選出18個天然小分子進入濕實驗室驗證階段。

研究團隊隨後使用人類HeLa細胞模型、線蟲和小鼠動物模型來驗證這些小分子化合物的自噬誘導能力。我們最後獲得兩個先導小分子化合物：山奈酚和丹葉大黃素。它們能在人體細胞、線蟲和小鼠神經系統中誘導顯著自噬。更重要的是，我們發現山奈酚和丹葉大黃素能大大改善患有阿爾茨海默症的小鼠的神經退行性改變，包括抑制AD的病理學病症（澱粉樣蛋白和微管相關蛋白的聚集）及增強學習和記憶能力，為激活線粒體自噬應用於AD治療這一策略提供了新的有力證據。研究結果已獲全球頂級學術期刊《自然 – 生物醫學工程》（Nature Biomedical Engineering）在線刊出（https://doi.org/10.1038/s41551-021-00819-5）。路嘉宏為論文的共同通訊作者，澳大博士生莊旭旭為論文共同第一作者。



以人工智能技術篩選阿爾茨海默病潛在藥物並作多物種分析的流程
The workflow of an AI-based virtual screening and cross-species analysis for the discovery of AD drugs

善用人工智能開發藥物

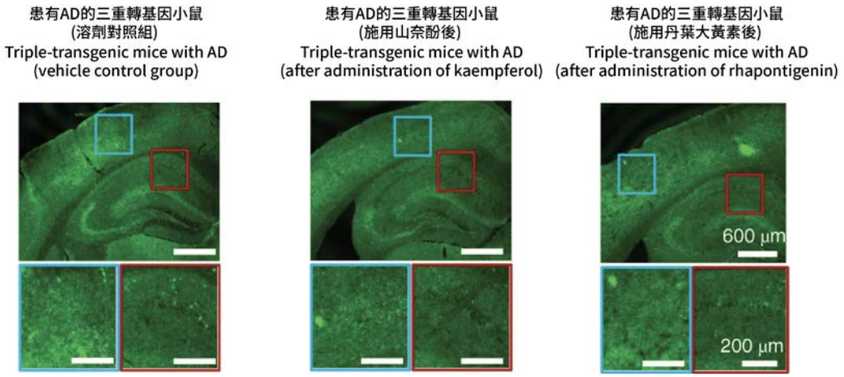
現代藥物研發耗資巨大，從最初的生物活性篩選，到發現先導化合物，再由科學家按經驗設計藥物及合成化合物、分子生物學家測試化合物活性，經反覆優化和篩選，最終發現臨床候選化合物，整個過程往往需要10到20年。然而，這些化合物最終只有12%能獲美國藥物管理局（FDA）認證。

隨著相關數據不斷積累，利用人工智能技術作虛擬藥物篩選，有望代替傳統的活性篩選方法，不僅能加快中間步驟，還可大幅降低研發成本，並且令藥物篩選更精確。我們的團隊與合作方致力於前期應用人工智能高效而低成本地篩選藥物，後期進行傳統的濕實驗室驗證（細胞、線蟲和小鼠）提高篩藥準確性，兩者結合可以加快藥物研發。這種設計思路不僅可用於AD藥物開發，還可在不同的醫學領域應用。

According to a national cross-sectional study published in 2020, the prevalence of dementia among people aged 60 and over in China is 6 per cent, with Alzheimer's disease (AD) patients accounting for 3.9 per cent. In other words, there are 15.07 million people aged 60 and over in China who have dementia, of which 9.83 million are AD patients. As China's population ages, the social and economic burden of AD will continue to increase. Despite the rising incidence, the development of AD drugs has been unsuccessful for decades. Although leading pharmaceutical companies invested more than USD 600 billion in AD research and drug development between 2000 and 2017, most of the drug developments have failed due to the unknown pathological mechanism of AD.

Mitophagy: A New Strategy to Treat Alzheimer's Disease

During the neuronal ageing process, damage to mitochondria, the 'power plants' within the cells, continue to accumulate, increasing the death of nerve cells. To ensure that mitochondria are in good condition, cells use mitophagy, a sophisticated quality control system, to selectively remove damaged mitochondria to maintain neuronal health. In our preliminary study, we found that damage to this system is key to the pathogenesis of AD. We have also found that stimulating mitochondrial phagocytosis can improve the pathology of animal models of AD and thus may be a promising new approach for the treatment of AD.



研究員在患有阿爾茨海默病的三重轉基因小鼠身上驗證兩款線粒體自噬激活劑的功效。這些免疫熒光染色圖顯示小鼠的大腦皮質和海馬體中對AT8抗體呈陽性的細胞。放大的藍框和紅框內是指定的大腦區域。

The researchers validated the capabilities of the two mitophagy inducers in triple-transgenic mice with AD. These immunofluorescence staining images show AT8-positive cells in the cortex and hippocampus of these mice. The magnified blue and red boxes show the designated brain regions.

However, mitogenic inducers are currently scarce, and safe triggers are particularly lacking. Therefore, we need more effective ways to find such inducers and build a safer bank of drug candidates. At the University of Macau (UM), our team is working with the University of Oslo and Hangzhou Mindrank Technology Co Ltd to develop an artificial intelligence (AI)-based virtual screening algorithm that integrates molecular data in multiple dimensions. The algorithm and multi-species AD validation models for cell culture systems, nematodes, and mice have enabled us to identify several small-molecule compounds with therapeutic potential against AD.

AI-assisted Identification of Mitophagy Inducers

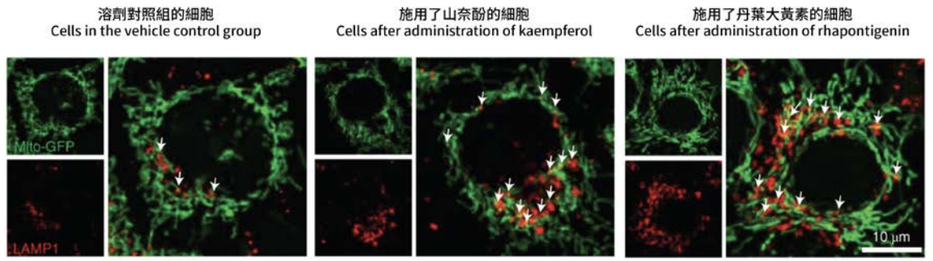
Over the years, our team at UM has worked on extracting natural small molecules from traditional Chinese medicine (TCM) as autophagy modulators. We have also conducted related pharmacological studies on biological activity and built a database of natural small molecules from different chemical classes, such as alkaloids, flavonoids and terpenoids. Our international cross-institutional partnership has led to the development of a machine learning model. The model was pre-trained on data from 19 million small molecules from the ChEMBL and ZINC databases. This representation model takes in molecular information of different dimensions. They include one-dimensional simplified molecular-input line-entry system (SMILES) sequence information, two-dimensional molecular topological similarity information, and three-dimensional spatial information. After obtaining the vector representations from the model, we grouped and filtered 3,724 natural small molecules and 14 known mitophagy inducers from our database. In the end, we selected 18 small molecules for validation in 'wet lab' experiments.

Our team then used human HeLa cells, and nematode and mouse models, to validate the autophagy-inducing capacity of these molecules. The final two candidate molecules are kaempferol and rhodopsin tannoy. Both induce significant autophagy in the nervous systems of human cells, nematodes, and mice. More importantly, we found that kaempferol and rhodopsin tannoy have a significant positive effect on neurodegenerative changes in mice with AD. These changes include inhibition of AD pathology (aggregation of amyloid and microtubule-associated proteins) and improvement in learning and memory. This provides compelling new evidence for the activation of mitophagy as an AD therapeutic strategy. *Nature Biomedical Engineering*, one of the world's leading academic journals, has published our research results online (https://doi.org/10.1038/s41551-021-00819-5). UM professor Lu Jiahong is a co-author and UM PhD student Zhuang Xuxu is a co-first author.

AI Empowers Drug Discovery

Modern drug development is a costly process that involves initial screening for biological activities and identification of lead compounds. This is followed by empirical drug design and synthesis of compounds by scientists, testing of compound activity by molecular biologists, and repeated optimisation and screening to identify clinical candidates. The entire process can often take a decade or two. However, less than 12 per cent of drugs in clinical trials receive approval from the US Food and Drug Administration (FDA).

Given the rich data available today, virtual drug screening using AI technologies is expected to replace traditional screening methods. This will not only speed up intermediate steps but will also significantly reduce R&D costs and increase the accuracy of screening. By combining AI-powered efficient and cost-effective screening in the first phase and traditional wet-lab validation on cells, nematodes, and mice in the second phase, we can improve the accuracy of screening and accelerate drug development. This approach can be applied not only to AD drug development but also to other areas of medical research.



研究員對GFP-mito-mCherry-Parkin HeLa細胞施用山奈酚和丹葉大黃素 (20 uM)，驗證這兩款線粒體自噬激活劑的功效。圖片顯示，施用這些自噬激活劑24小時後，這兩組細胞內的線粒體 (Mito-GFP) 和溶酶體 (LAMP1抗體) 的共定位有所強化，比在溶劑對照組的同類細胞有更多線粒體自噬活動 (以白色箭嘴標示)。

The researchers administered kaempferol and rhapontigenin (20 uM) to GFP-mito-mCherry-Parkin HeLa cells to validate their ability to induce mitophagy. The images show that 24 hours after administration of these two mitophagy inducers, co-localisation of mitochondria (Mito-GFP) and lysosomes (LAMP1 antibody) was enhanced in the two groups of cells, which had more mitophagy events (indicated by white arrows) than the same type of cells in the vehicle control group.

莊旭旭是澳大中華醫藥研究院博士生，研究課題集中於轉錄因子EB介導的自噬調控機制，以及通過化學或遺傳學方法激活自噬對神經退行性疾病的干預。他在2016年於中國藥科大學取得碩士學位，曾以第一作者 (包括共同第一作者) 身份在期刊《Nature Biomedical Engineering》和《Cell Death & Disease》發表論文。

Zhuang Xuxu is a PhD student in the Institute of Chinese Medical Sciences (ICMS) of UM. His research interests include the regulation of autophagy which is mediated by the transcription factor EB, and the intervention in neurodegenerative diseases by activating autophagy through chemical or genetic means. He received his master's degree from China Pharmaceutical University in 2016. He has published two papers as the first author (or as a co-first author) in journals including *Nature Biomedical Engineering* and *Cell Death & Disease*.

路嘉宏是澳大中華醫藥研究院、中藥質量研究國家重點實驗室 (澳門大學) 副教授和課程主任，主要研究興趣是細胞自噬功能異常在神經退行性疾病中的作用和機制，以及篩選有抗神經退行性疾病治療潛力的中藥小分子自噬調控劑，從而開發新藥。他已在《Nature Biomedical Engineering》、《Nature Communications》和《Autophagy》等學術期刊發表100多篇論文，獲引用逾10,000次 (Google Scholar數據)，正申請多項專利。

Lu Jiahong is an associate professor and programme director in the ICMS and the State Key Laboratory for Quality Research in Chinese Medicine (University of Macau). His team's research interests include the role and mechanism of abnormal cell autophagy in neurodegenerative diseases, and the screening of small molecule autophagy modulators in Chinese medicinal products with therapeutic potential against neurodegenerative diseases for new drug development. Prof Lu has published over 100 papers in international journals, such as *Nature Biomedical Engineering*, *Nature Communications*, and *Autophagy*, with over 10,000 citations (Google Scholar data). He is in the process of applying for a number of patents.

「學術研究」為投稿欄目，內容僅代表作者個人意見。

Articles in the Academic Research column were submitted by UM scholars. The views expressed are solely those of the author(s).

鄭裕彤書院創業模式下的創業項目：澳門 BioPeTech 環保麥芽貓砂

The BioPeTech Malted Cat Litter Produced in Macao — A Project under the CYTC Entrepreneurship Model

文/黃承發、鄧宇明、付昊明．圖/鄭裕彤書院提供．英文翻譯 / 校園記者程若琛
Chinese / Alfred Wong Seng Fat, Tang U Meng, Fu Haoming．Photo / Cheng Yu Tung College．
English Translation / UM Reporter Carina Cheng

隨著國家「十四五」規劃和2035年遠景目標的發佈以及橫琴粵澳深度合作區的建設與發展，澳門經濟的適度多元發展迎來新機，大學科研成果的產業化也有更廣闊的空間與機遇。澳門大學校長宋永華教授介紹澳大未來五年的發展藍圖時表示，將會持續完善以「四個三」為中心的科研戰略佈局，構建「五位一體」研究創新及轉化體系，開闢大學科研成果產業化路徑、構建立足澳門的社會服務平台。為響應澳大對產學研發展的方針，鄭裕彤書院在培育院生創業項目的過程中，成功探索出書院創業模式，透過與學院及業界友好合作，將科技與創意思維融入書院創業模式，在推進澳大產學研一體化的進程發揮積極作用。

四方面支援院生創業

在鼓勵書院學生創業、支持創業項目落地壯大方面，鄭裕彤書院的創業模式已有明顯成效。2018年至今在書院創建的5個創業團隊共獲創業獎16項，獎金及融資共265,000澳門元及人民幣200,000元。其中，澳門BioPeTech環保麥芽貓砂便是該創業模式的創新實踐之一。鄭裕彤書院創業模式為書院創業團隊提供多方面的支援，分別是：1.書院社群教育；2.創意概念落地；3.科技支持；4.參與創業比賽及進駐孵化中心。

書院社群教育

書院社群教育是鄭裕彤書院創業模式的第一步，將創業理念融入書院教育與社區氛圍，潛移默化培育院生的創業熱情與理念。澳門BioPeTech環保麥芽貓砂團隊由院生譚佩詩、唐敏、付昊明、王正浩組成，團隊顧問包括書院代院長黃承發教授及書院導師鄧宇明博士。團隊旨在將釀製啤酒時產生的麥芽渣轉化成環保、健康、優質的貓砂。麥芽貓砂項目的構思源於鄭裕彤書院的另一個創業項目——2048趣眼精釀。

2048趣眼精釀是澳門唯一本地生產的精釀啤酒廠，其釀酒時的副產品麥芽渣在澳門並無下游產業消化，造成資源浪費。這點啓發了項目團隊將麥芽渣轉化成貓砂的創業妙思。麥芽貓砂團隊除了從書院創業的「產業鏈」中形成思路，還在書院活動中相互協調、培養默契。為了建設項目團隊、完善項目構思，導師舉辦了多場讀書會，讓學生學習貓砂的生產技術與行業生態。讀書會吸引了20多名院生參加，他們最終匯集出一份成熟的商業計劃。

創業概念落地

創業項目前期面臨的主要困難是將概念落地。書院從多方面提供的支持大大幫助項目團隊越過初期概念落地的溝壑。書院除了能提供場地和物質層面支援，還能結合澳門本地資源為項目團隊提供實踐理念的途徑與機遇。麥芽貓砂項目團隊在書院支持下，經過多次配比實驗與性能測試，成功製作出產品原型。他們已開始與澳門愛護動物協會合作和進一步測試產品。團隊成員在協會做義工，同時收集貓砂使用反饋及相關數據，改良產品。

科技支持

科技實力是創業項目切實可行與長久領先的重要保障。因此，書院注重為創業項目提供和尋找科技支援。麥芽貓砂項目所使用的科技成果「噬糖真菌」便是在書院非駐院導師、健康科學學院譚建業教授的技術指導下開發。團隊以噬糖技術把廢棄麥芽渣的殘糖

鄭裕彤書院代院長黃承發教授（右三）、書院導師鄧宇明博士（左三）和書院的環保麥芽貓砂學生創業團隊。
UM Cheng Yu Tung Interim College Master Prof Alfred Wong Seng Fat (3rd from right), Resident Fellow Dr Tang U Meng (3rd from left), and the college's entrepreneurial team which produces eco-friendly malted cat litter.

噬走，以避免幼貓誤食糖分影響健康。透過書院牽綫，環保麥芽貓砂項目與香港科技大學的技術方合作，項目在雙方努力下已進駐香港科技園作進一步研發，推動及保證了噬糖真菌的穩定研究和開發，為創業項目的穩步推進奠下基石。

參加創業比賽及進駐孵化中心

對於澳門的初創團隊而言，創業比賽是團隊汲取初期資金及專業見解的寶貴機會。而進駐孵化中心更是為項目團隊的前期健康發展起到難以代替的作用。因此，鄭裕彤書院持續支持及指導創業項目團隊進駐孵化中心接受專業培訓並持續參加創業比賽，使項目的構思更加貼地與成熟。

麥芽貓砂團隊於2021年11月進駐澳大創新創業中心，在該中心的教授支持下茁壯成長。在各界人士和機構幫助下，他們的企劃不斷完善，並在第10屆「贏在廣州」暨粵港澳大灣區大學生創業比賽與百餘支參賽隊伍角逐獎項，最終在決賽排名第九，獲三等獎的優秀成績。

As Macao is seizing new opportunities for its moderate economic diversification brought by China's 14th Five-Year Plan and Vision 2035 plan, as well as the Guangdong-Macao In-Depth Cooperation Zone in Hengqin, universities in the city are also seeing a more conducive environment for commercialising their research results. When elaborating on the University of Macau's (UM) development plan for the next five years, Rector Prof Yonghua Song says that the university will continue to improve its '3+3+3+3' research strategy and establish a '5-in-1' system for research innovation and results transfer, finding a path for the commercialisation of research results, as well as actively building a social service platform for Macao. To support the university's commitment to promoting industry-academia collaboration, UM's Cheng Yu Tung College (CYTC) has developed a model of student entrepreneurship from its experiences with encouraging students to start their own businesses. Known as the CYTC Entrepreneurship Model, the model will not only establish close partnerships with faculties and industries, but will also bridge the gap between technology and creativity among students in residential colleges (RCs), thus enabling the colleges to play an active role in supporting the university in academia-industry collaboration.

Four Ways to Support Student Start-ups

The CYTC Entrepreneurship Model has come a long way in encouraging CYTC students to launch their own businesses and get their commercial ideas off the ground. As of today, the college has formed five entrepreneurial teams, which have received 16 awards since 2018, with a total of MOP 265,000 and

學生創業團隊將麥芽渣轉化成貓砂
The student business team turns brewers' spent grain into cat litter

學生創業團隊製作的環保麥芽貓砂
The eco-friendly malted cat litter produced by the entrepreneurial team

RMB 200,000 in prize money and investment. Many innovative projects have been developed under the model. An outstanding example is a project focusing on the production of eco-friendly malted cat litter under the brand BioPeTech in Macao. The team received support from the college in four areas: 1) community and peer education; 2) yield of innovation; 3) technical support; 4) competition and incubation.

Community and Peer Education

Community and peer education is the first step in the CYTC model. The college cultivates entrepreneurship as part of its educational mission, to ignite students' passion for starting a business and to expand their entrepreneurial vision. As a result of this culture, the team that produced BioPeTech eco-friendly cat litter consists of four CYTC students, namely Tam Pui Si, Tong Man, Fu Haoming, and Wang Cheng Hao. CYTC Interim Master Prof Alfred Wong Seng Fat and Resident Fellow Dr Tang Yu Ming serve as their advisors. The team successfully turned spent grain (brewer's spent grain, BSG) from a local brewery into eco-friendly, healthy, and quality cat litter. This business idea was inspired by Funny Eye Brewery - 2048, another CYTC business project.

Funny Eye Brewery - 2048 is the only brewery in Macao. Its BSG, which is a by-product of the beer brewing process, has no local commercial use. This waste of resources prompted the student team to find a way to recycle the beer waste into cat litter. The team not only drew on past experiences under the college's entrepreneurship model, but also forged close ties with each other during various activities in the college. To encourage the students to refine their business ideas, the instructors organised a series of reading sessions, in which the students learned about cat litter production techniques and the current development of the industry. These reading sessions, which attracted over 20 students, resulted in a well-developed business plan.

Yield of Innovation

The main difficulty in starting a new business is getting the concept off the ground. CYTC offered entrepreneurial teams a wide range of support to put their ideas into practice. In addition to providing workspace and material support, the college also mobilises local resources. With the support of the college, the entrepreneurial team carried out numerous experiments and performance tests to develop a prototype. Further testing is underway in partnership with the Society for the Protection of Animals (Macau), commonly known as Anima. The team visited Anima to volunteer and collect feedback and data on the use of cat litter, which is very important for further improving their malted litter product.

Technical Support

An entrepreneurial project must have technological prowess in order to be feasible and successful in the long run. Therefore, the college places great importance on providing and locating technical support for its entrepreneurial teams. The technology used in the malt litter project, namely sugar phagocytic fungus, was developed under the guidance of Tam Kin Yip, associate professor in the Faculty of Health Sciences and non-resident fellow of CYTC. This technology helps to absorb sugar from BSG to prevent kittens from consuming sugar by accident. Through the college, the team has partnered with researchers from the Hong Kong University of Science and Technology. Thanks to the efforts of both parties, the cat litter project has entered a new phase of R&D at the Hong Kong Science Park, which ensures a stable production and development of the fungus, laying a solid foundation for the project's expansion.

Competition and Incubation

Competitions present excellent opportunities for start-ups, particularly those in Macao, to gain initial funding and professional advice. Business incubators also play an irreplaceable role in putting start-ups on the right trajectory for success. This is why CYTC relentlessly supports and guides its student entrepreneurial teams to receive professional training in business incubators and to participate in start-up competitions. This will allow them to develop their business ideas and get closer to the needs of the market.

The cat litter entrepreneurial team began its incubation at the UM Centre for Innovation and Entrepreneurship in November 2021. With the support of the centre's professors and various local organisations, the team's business plans have been improving steadily. At the 10th Guangdong-Hong Kong-Macao Greater Bay Area Student Entrepreneurship Competition held in Guangzhou, the team competed against more than 100 teams and placed ninth in the final, winning a third prize.

黃承發教授是澳大鄭裕彤書院代院長，也是機電工程系副教授，其研究領域涵蓋人因工程、智慧城市、醫工融合、企業資源計劃系統、協同產品開發管理、工業工程、知識管理等。他領導澳大工業工程實驗室，為澳門和全球的製造和服務機構提供各種解決方案。

Prof Alfred Wong Seng Fat is the interim master of CYTC and an associate professor in the Department of Electromechanical Engineering at UM. His research interests include human-factors engineering, smart cities, medical and engineering Integration, enterprise resource planning systems, collaborative product development management, industrial engineering, and knowledge management. He leads the Industrial Engineering Laboratory at UM to offer solutions to manufacturing and service organisations in Macao and around the world.

鄧宇明博士是澳大鄭裕彤書院導師，致力於指導院生參與創新創業大賽，歷年獲獎16項，相關創業項目衍生了四間公司，包括2048（澳門）趣眼精釀及環保麥芽貓砂製造商BioPeTech (Macau)。

Dr Tang U Meng is a resident fellow of CYTC at UM. He is committed to guiding students in his college to participate in innovation and entrepreneurship competitions. Together they have won 16 awards and created four companies, including 2048 (Macau) Co, Ltd (with the brand Funky Eye Brewery) and BioPeTech (Macau), a producer of eco-friendly malt cat litter.

付昊明是澳大鄭裕彤書院和歷史系本科生，也是澳門BioPeTech環保麥芽貓砂創業項目團隊的核心成員。

Fu Haoming is an undergraduate student in CYTC and the Department of History at UM. He is also a core member of the student team that started BioPeTech (Macau), a producer of eco-friendly malt cat litter.

「書院發展」為投稿欄目，內容僅代表作者個人意見。
RC Development is a submission column. The views expressed are solely those of the author(s).

澳大於2010年引入住宿式書院系統。書院作為多元文化與多元學科融會貫通的知識整合學習平台，致力培養學生具有公民責任心、全球競爭力、知識整合能力、團隊協作、服務與領導、文化參與和健康生活的七項勝任力。
UM launched its residential college (RC) system in 2010 to create a multicultural and multidisciplinary learning platform for knowledge integration. RC education aims to cultivate seven competencies of students, namely responsible citizenship, global competitiveness, knowledge integration, teamwork and collaboration, service and leadership, cultural engagement, and healthy lifestyle.

住宿式書院系統網站
Website of the Residential College System

滿珍紀念書院：跨學科的國際化書院

Moon Chun Memorial College: A Multidisciplinary and International Institution

文 / Manuel Noronha、劉沛棋、洪盈惠．圖 / 滿珍紀念書院提供．中文翻譯 / 葉浩男
English / Manuel Noronha, Peggy Lau & Alice Hong．Photo / Moon Chun Memorial College．Chinese Translation / Davis Ip

澳門大學的本科新生每年都會隨機分配到校內10所住宿式書院之一，往後四年都會是該書院一員。書院學生有不同的背景、學術興趣、才能和學習動機，形成一個多元多彩的群體。

創院院長湯柏燊教授
Prof Kit Thompson, founding master of the college

「比起你的成績，
我們更關心你的成長。」
"We care about you more than your GPA."
創院院長湯柏燊教授
Founding College Master, Prof Kit Thompson

協助學生成長的教育模式

滿珍紀念書院（以下簡稱書院）擁有鮮明的當代特質，充滿跨學科和國際化色彩，不受階級觀念和繁文縟節所束縛。書院深明「連結」的重要，這點在書院的跨學科和國際化教育中展露無遺。書院致力於建立超越國家和文化界限的友誼，這些工作的目標都是協助學生成功和活出圓滿的人生。

以下簡介一些活動，展現學生在書院的真實體驗和參與。

駐院國際音樂家

書院不時接待著名作曲家、表演者和樂團。蒞臨書院的音樂家除了演出，還會舉辦大師班、輕鬆的討論會和工作坊等，有些音樂家更會短期駐院，為院生帶來精彩的表演、展覽和新作。書院的編外導師湯狄芳娜博士近年致力策劃和鼓勵師生參與這些活動，成效顯著。

駐院合唱團

書院有幸曾接待專精各類音樂傳統的合唱團，包括劍橋大學書院的唱詩班和樂團、牛津大學基督大教堂合唱團。2015年12月10日，劍橋大學岡維爾與凱斯學院的合唱團在書院大廳公開排練，吸引大批聽眾，讓澳大師生盡情欣賞世界級合唱團美妙的表演。

劍橋大學克萊爾學院的合唱團也曾在2017年到訪書院，在書院大廳舉行非正式公開排練，同樣吸引許多聽眾。在音樂總監Graham Ross帶領下，合唱團演唱英國作曲家Ralph Vaughan Williams和John Rutter的作品。

音樂指導

書院的學生在崇尚合作和創意的環境學習，餘暇會參與澳門各類社區活動，與不同群體分享他們對音樂和文化交流的熱情。書院不僅鼓勵學生參加演奏會和表演，還會訓練他們成為音樂導師，帶領同儕追求音樂知識。書院也會舉辦音樂欣賞會和分享會，營造濃厚的音樂和文化氛圍。

高桌晚宴

書院會舉行盛大的高桌晚宴，期間院長湯柏燊教授和湯狄芳娜博士會接待嘉賓、導師和新生。高桌晚宴是較為正式的活動，出席者須穿著禮服。書院成員和來賓穿著學術袍，本科生則穿黑禮服（sub fusc）或晚禮服。高桌晚宴在書院大廳舉行，擁有迷人的氛圍，為學生和導師提供理想環境交流觀點和欣賞優雅的音樂表演。

音樂指導
Music direction

高桌晚宴
High table

進入文學世界接觸作家和詩人

書院歷年舉辦過多場文學研討會，有不少國際知名作家出席，包括2012年普利策小說獎得主Adam Johnson、蘇格蘭作家Graeme Macrae Burnet、愛爾蘭作家Marita Conlon-McKenna，以及美國亞裔作家張彤禾。

提升英語和葡語能力

書院提倡動覺學習，希望學生從遊戲和互動活動中獲益。一些學生定期參與English-in-Action系列活動。他們共同決定活動的內容和互相學習，經常參與Jeopardy和Quiz Night等問答比賽，訓練英語聽、說、讀、寫能力。

書院還曾舉辦「A Mesa Portuguesa」（葡語餐桌）活動，為學生創造一個輕鬆的機會練習葡語聽說能力，並且孕育和激發他們的語言發展和對答技巧。來自不同書院、葡語程度不同的學生紛紛抽空與駐院學人雷祖善博士交談，並在葡語環境下晚餐。

訓練體育能力

書院重視學生的領導能力、團隊精神和健康生活習慣，視之為體驗教育及同儕教育的重要元素。憑藉有力和動人的核心價值，書院培養了不少充滿團隊精神和競爭力的運動員。他們不單代表澳大參與校際比賽，也參加澳門的本地聯賽和代表隊選拔。

情緒關懷輔導和社會責任

新冠疫情防控措施對學生的生活和健康帶來影響。因此，駐院導師採取了多項重要的應對措施，擴大對學生的支援網絡，包括與駐院的社會工作者合作，為學生提供情緒關懷和輔導，同時參加與「一步步」心理健康應用程式相關的支援計劃。

此外，書院推出了義工服務和社區服務等不少新項目，培養學生的社會責任感。他們的服務對象包括長者、精神病患者及智障人士。學生從服務中學習，增進了對人口老化、抑鬱症和社會共融等議題的了解。在反思和互相幫助的過程中，他們能夠審視和提升對社會問題和人生價值的認識。

Each year, first year students at the University of Macau (UM) are randomly assigned to one of ten residential colleges, and they maintain membership in the same college throughout their undergraduate years. The collegiate system is undoubtedly enriched by the diversity of its students, and their academic interests and expectations, talents, and drive.

An Educational Model to Help Students Grow

The Moon Chun Memorial College (MCM College) can best be described as contemporary: an international institution that is multidisciplinary yet is free of unnecessary hierarchy or fusty rituals. This college believes in connectivity, which is multidisciplinary and international; friendships across borders and cultures. All these work towards the ultimate goal, which is to facilitate student success and help them live their lives to the full.

Below are several signature events that define the authentic experiences and engagement of the college.

International Musicians in Residence
The college receives renowned composers, performers, and ensembles to present and perform, and hold master classes, informal discussions, and workshops. These visitors engage in short-term residencies which culminate in performances, exhibitions, and new works. In recent years, Supernumerary Fellow Dr Patricia Thompson has effectively involved both students and faculty members.

Choral Groups in Residence
The college has had the privilege of hosting a rich tradition of choral music, from chapel choirs to ensembles specialising in other genres from collegiate Christ Church Cathedral Choir, Oxford; and Cambridge, UK.

On 10 December 2015, the college was delighted to host an open rehearsal by the Choir of Gonville and Caius College, University of Cambridge, in College Hall to a capacity audience. Students and faculty colleagues from across UM greatly enjoyed experiencing the musical processes by which a world-class choir is produced. In 2017, Clare College Choir University of Cambridge held an informal open rehearsal to a capacity audience in College Hall. The Choir's Director of Music, Graham Ross, led the group through choral works by English composers Ralph Vaughan Williams and John Rutter.

Music Direction
Through an environment of collaboration and creation, MCM College students continue to share their passion for music and culturally interact and engage with the Macao community during special festivities. Apart from recitals and performances, our students are trained to be music teachers by guiding their peers in their pursuit of musical knowledge and offering music appreciation sharing workshops, further enriching the college's music and cultural environment.

High Table
College Master Prof Kit Thompson and Supernumerary Fellow Dr Patricia Thompson receive distinguished guests, fellows and first-year students to a magnificent Commencement High Table: a black-tie event where members of the college and guests don academic robes and undergrads choose sub-fusc or evening dress. Our College Hall creates a most charming setting and atmosphere – one that is conducive to concentration and ideal for the exchange of views and insights as well as suave musical performances.

Writers and Poets: The Script Road
The college has hosted several literary workshops over the years featuring some internationally acclaimed writers such as 2012 Pulitzer Prize winner Adam Johnson, Scotsman Graeme Macrae Burnet, Irish writer Marita Conlon-McKenna, and Asian American writer Leslie Chang.

English and Portuguese Language Enhancement Activities
MCM College is dedicated to developing kinesthetic learning, where students benefit from learning through games and interactive activities. Regular participants of the English-in-Action series support each other, make decisions together and learn from one another. Popular games such as Jeopardy and Quiz Night involve all aspects of language: listening, speaking, reading, and writing.

'A Mesa Portuguesa' provided informal opportunities for students to practise speaking and listening skills in Portuguese. It was intended simply to 'nourish' and motivate language development and conversational skills. Participants of all levels (across the colleges) took time out from their busy schedules to speak with Visiting Scholar in Residence, Prof Joseph Levi, and fully immerse in a Portuguese-speaking environment over dinner.

Sporting Prowess
The college places a strong emphasis on leadership, teamwork, and healthy living as part of its experiential and peer learning programme. With such powerful and evocative core values firmly instilled, the college has managed to build successful team spirit and sporting prowess among its many competitive athletes, who not only represent the university at the intervarsity level, but also participate in Macao's local sporting leagues and national team selections.

Pastoral Care and Social Responsibility
Under strict protocols and preventative measures of the Covid-19 pandemic era, students' lives and well-being have been adversely affected. The college's resident fellows implemented important initiatives to strengthen students' supporting network with the collaboration of an assigned social worker's on-site pastoral care, as well as a 'Step by Step' digital mental health programme.

Many new projects such as volunteering and community service activities aim to nurture social responsibility. Service targets include the elderly, the mentally ill, and the mentally disabled. Educational approaches to service-learning raise students' awareness of social issues: ageing, depression, and inclusive community. Through reflection and reciprocity, students examine and enhance their own perceptions of social issues and life values.

Manuel Noronha博士2014年加入澳大滿珍紀念書院並出任副院長至今。他管理書院的發展和學術輔導課程、日常運作、學生的生活和紀律，並向學生提供輔導和情緒關懷。

Dr Manuel Noronha joined MCM College at UM in 2014 as associate master. He oversees student life and general operations in the college and provides student counselling and pastoral care, as well as managing student discipline, supervising, and organising developmental and academic tutorial programmes in the college.

劉沛棋博士是澳大滿珍紀念書院駐院導師。她在美國密歇根州立大學獲鋼琴教育學和鋼琴演奏碩士學位以及鋼琴演奏博士學位，在策劃書院活動方面經驗豐富。

Dr Peggy Lau is a resident fellow of MCM College at UM. She received her master's degrees in piano pedagogy and piano performance and doctoral degree in piano performance from Michigan State University. She has vast experience in hosting resident hall activities.

洪盈惠是澳大滿珍紀念書院駐院導師，也是經驗豐富的學生輔導員。她擅長各類教育和培訓，包括人際交往和領導能力培訓、義務培訓、生涯輔導、性教育、品格教育和生命教育。

Alice Hong is a resident fellow of MCM College at UM. She is an experienced student counsellor, and specialises in interpersonal and leadership skills training, volunteer training, career guidance, sexuality education, character education, and life education.

文學研討會
Literary workshops

訓練體育能力
Sporting prowess

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澳門大學

UNIVERSIDADE DE MACAU
UNIVERSITY OF MACAU

ISSN 2077-2491