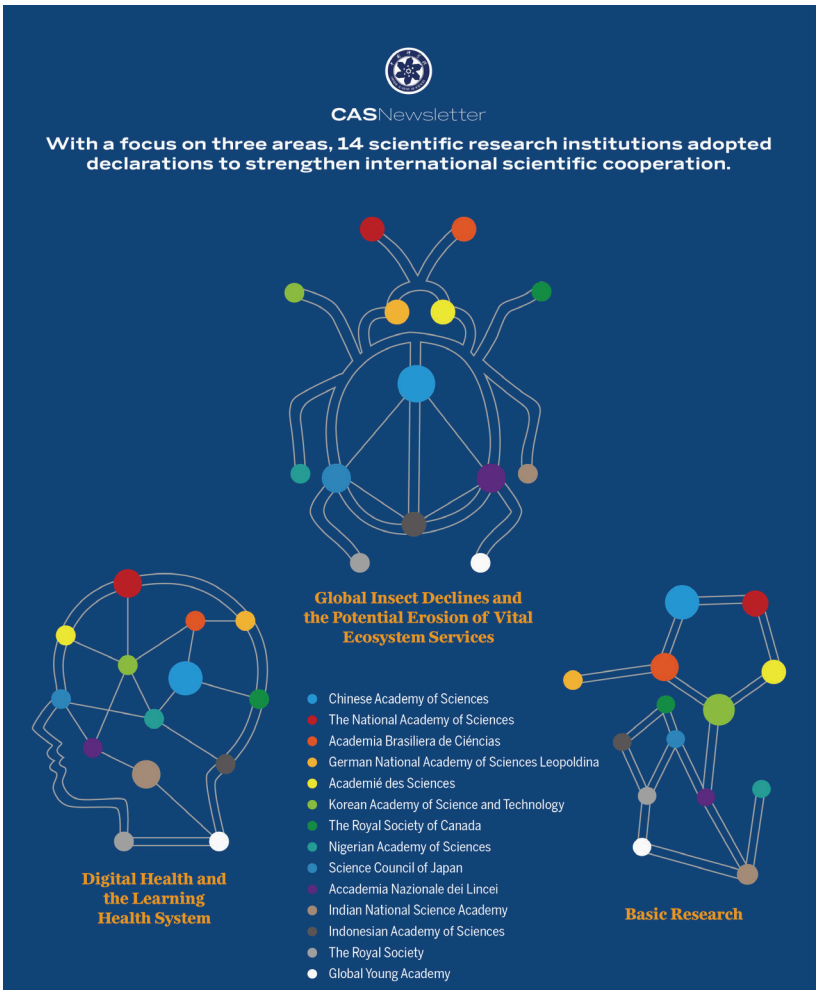
中国科学院
CHINESE ACADEMY OF SCIENCES

CASNewsletter

NO. 165 • July 2020

LEAD ARTICLE



CAS and international academies issue scientific declarations

The Chinese Academy of Sciences (CAS) and 14 international academies of sciences, including the National Academy of Sciences (NAS), jointly issued declarations regarding basic research, digital health and the learning health system, and global insect declines and the potential erosion of vital ecosystem services on May 28 in a bid to provide the international community with references for policy-making.

>> PAGE 4

HOT ISSUE

Together online

The epidemic could not stop scientific and technological cooperation.
>> PAGE 2

RESEARCH PROGRESS

A review of quantum secure communication

Quantum communication is an important branch of quantum information science. It refers to the communication technology that uses quantum bits as information carriers for information transference. >> PAGE 5

SCIENCE STORY

Bringing new crops to China: Yunnan Avocado Co. takes root in Lijiang

I first began this venture to introduce new fruit varieties into China after obtaining my PhD from CAS's very own Kunming Institute of Botany.
>> PAGE 7

NEWS IN BRIEF

USTC Grad School enrolls students through live-streaming

For the first time, the Grad School of the University of Science and Technology of China (USTC) used livestreaming to introduce and present its faculty team, research programs, and campus life. >> PAGE 8

Edited by Bureau of International Co-operation, Chinese Academy of Sciences
CAS Newsletter – Monthly – Editorial Board: 52, Sanlihe Road, Beijing, 100864, China

TOGETHER ONLINE

In spite of the COVID-19 pandemic that has raged all over the world for nearly three months, the Chinese Academy of Sciences (CAS) has made great efforts to continue its research cooperation with international institutions. Through video conferences, academic seminars were successfully held with the National Australian Institute of Science and Technology (NAIST), the Max Planck Institute for Astronomy (MPIA), the National Academy of Sciences, United States, and the John Innes Centre, JIC, laying a foundation for future cooperative projects.

The epidemic could not stop international scientific and technological cooperation.

Since the epidemic first arose the Internet has played an important role in promoting scientific exchanges between countries. Scientists in China and abroad believe that a long-term online dialogue mechanism should be established to promote scientific prevention and control of COVID-19 through academic exchange.

1. CAS president attends 23rd annual meeting of the UNCSTD

At the invitation of the Secretariat of the United Nations Commission on Science and Technology for Development (UNCSTD), Bai Chunli, President of CAS and the Alliance of International Science Organizations in the Belt and Road Region (ANSO), attended the 23rd annual meeting of the UNCSTD by video conference on June 11 and made a keynote speech under the theme of "Exploring Space Technology for Sustainable Development and Carrying Out Related International Cooperative Research".

"The COVID-19 pandemic has made us realize more than ever before the importance of solidarity, international cooperation and the need for science and innovation in our fight against our common challenges," Bai said. "The epidemic also poses major challenges to food security in many countries."

The availability and transparency of crop information is a challenge for developing countries as they lack their own crop monitoring and analysis systems. An important monitoring system is urgently needed to promote scientific decision-making and ensure food security. CAS boosts strong advantages in remote sensing satellite earth observation and is actively establishing cooperation with developing countries in crop monitoring.

The global crop monitoring cloud platform (CropWatch) independently developed by CAS can help developing countries obtain agricultural information and crop monitoring and analysis through remote sensing data. The platform used in countries along the "Belt and Road" such as Mozambique has achieved remarkable results and helped increase their access to food information.

>> **PAGE 3**

>> **PAGE 2**

Bai also introduced the progress made by CAS in the fight against the novel coronavirus and more information about ANSO. He announced that within the framework of the UNCSTD and ANSO cooperation, the ANSO agricultural yield estimation innovation plan will be launched and more efforts will be made to promote the application of CropWatch through training, technology transfer, and localization. Ministers of science and technology and representatives of scientific research institutions from Egypt, Botswana, Germany, France, Saudi Arabia, Russia and Japan, as well as officials of relevant UN agencies attended the meeting. The United Nations Conference on Trade and Development (UNCTAD) published a special report on the meeting on its official website.

2. CAS and CSIRO collaborate on various research fields

CAS and the Commonwealth Scientific and Industrial Research Organization (CSIRO) held five thematic workshops online from June 16 to June 24. Focused on climate change impact, sustainable agriculture, health and biotechnology, nanotechnology and new energy materials, and marine science and the blue economy, participants shared experiences, exchanged ideas, and conducted in-depth discussions on the progress of project cooperation between the two organizations in the above-mentioned fields as well as the direction and model of future cooperation. Around 150 scientists and researchers from CAS and the CSIRO participated in the workshops.

3. CAS and MPIA hold video meeting on fight against novel coronavirus

CAS and the Max Planck Institute for Astronomy (MPIA) held a video seminar on scientific research cooperation against the novel coronavirus on May 13. CAS introduced research progress in combating COVID-19, focusing on its basic research in structural biology, viral biology, and drug mechanism. It also outlined the results of vaccine research, drug research and development, and animal model establishment. It shared with the German side two databases — "2019 Novel Coronavirus Information Database" and "Novel Coronavirus National Science and Technology Resource Service System". The MPIA introduced its efforts to fight against the epidemic, research and develop vaccines and drugs, and presented its establishment of animal models, development of mathematical prediction models, and psychological assistance programs. The two sides said they will further strengthen scientific interaction and seek cooperation opportunities in basic novel coronavirus research.

4. CEPAMS renews cooperation agreement for another five years

The CAS-JIC Centre of Excellence for Plant and Microbial Science (CEPAMS) jointly established by CAS and the John Innes Centre signed a new five-year cooperation agreement on April 27 to continue their scientific research cooperation in the fields of food security and natural medicinal products. The CEPAMS was jointly established by the CAS Institute of Genetics and Developmental Biology (CAS-IGDB), the CAS Center for Excellence in Innovation in Molecular Plant Sciences/Institute of Plant Physiology and Ecology, and the John Innes Centre in 2014. Since its establishment, the CEPAMS has employed nine long-term researchers including three foreign individuals in Beijing and Shanghai, and launched 29 bilateral cooperation projects. In addition, it has published 19 cooperative papers in international journals, such as *Science* and *PNAS*.

5. Chinese and American institutions hold video meetings on COVID-19 prevention and control

From May to June, CAS, the National Academy of Sciences, United States, the American Academy of Medical Sciences and other institutions in the United States held a series of video conferences on COVID-19 prevention and control. Over 30 experts discussed COVID-19 patient treatment and management, measures to contain the spread of the novel coronavirus, steps to restart society, and the experience of fighting against the epidemic.

6. CAS-CEA Sino-French Carbon Cycle Forum takes place

CAS and the French Alternative Energies and Atomic Energy Commission (CEA) held a video academic seminar on carbon cycles on June 23, in which scientists from both sides exchanged ideas on thermal catalysis, photo/electric catalysis, and biocatalytic carbon dioxide conversion. More than 40 people from China and France attended the meeting. A kick-off video conference about the seminar had been held nearly one month earlier, on May 26.

7. Superconducting quantum computation makes progress

A research group from CAS's Institute of Physics, Zhejiang University and RIKEN in Japan has successfully performed quantum simulation of dynamical phase transitions in a Lipkin-Meshkov-Glick model with a 16-qubit superconducting quantum simulator. The results were published recently in the

>> **PAGE 4**

>> **PAGE 3**

international academic journal *Science Advances*. The current tasks accomplished by quantum simulation are still within the calculation range of computers, and the main purpose of the experiment is to show that the quantum computation platform can operate according to the expected quantum mechanics. With the growth of the number of qubits, the future quantum simulation will be able to accomplish tasks that cannot be predicted and tested by computers, and its role will be irreplaceable.

8. Cutting-edge scientific research cooperation on Central Asia Tajik Basin early cenozoic strata

With the joint funding of the National Natural Science Foundation of China General Program (No. 41672158), "the Second Comprehensive Scientific Investigation of the Qinghai-Tibet Plateau" special project (2019QZKK0602), the Natural Science Foundation of the United States Project (EAR-1450917), and the German Helmholtz Federation Youth Fund Project (PD-301), the research team of Academician Chen Fahu with the Qinghai-Tibet Plateau Institute of CAS, and the Asian inland dust and drought research team of Associate Professor Wang Xin at Lanzhou University's Key Laboratory of Western Environment of the Ministry of Education conducted in-depth research work on the Central Asia Tajik Basin early cenozoic strata. Through cooperation with a number of research institutions in the United States, Germany, and Tajikistan, the scientists found the inland climate environment in Asia has produced significant east-west differentiation since around 25 million years ago and part of the Pamir-Tianshan mountain ranges may have risen to a critical height (about 3000 meters above sea level) that can produce a circulation effect. The research reveals that the Pamir-Tianshan tectonic uplift and its mechanical diversion of westerly circulation are the main reasons for the formation of the inland climate and environmental patterns of Asia.

9. Scientists collaborate on the origin of domestication of alpaca and llamas

The Institute of Zoology of CAS cooperated with scientists from Cardiff University, the United Kingdom, Universidad del Bío-Bío, Chile, and other domestic and foreign scientific research institutions to publish a research paper titled "Genomic analysis of the domestication and post-Spanish conquest evolution of the llama and alpaca" online on *Genome Biology* (https://doi.org/10.1186/s13059-020-02080-6), on July 2. The paper explains the origin of alpaca and llamas, discovers a wide range of asymmetric gene infiltration between the two species, and reveals the changes in the traditional local animal husbandry management methods in South America caused by the Spanish conquest from the perspective of domestication.

Source: Bureau of International Co-operation, Chinese Academy of Sciences

---

>> **PAGE 1**

The basic research declaration says the development of basic science has a crucial impact on human society and it calls for relevant policies to restore and guarantee public funding and investment in basic research. Enhanced education in science, technology, engineering and mathematics will help build capacity, promote global scientific and technological cooperation and exchanges, and strengthen the disclosure of scientific and technological achievements, said the declaration.

The digital health and the learning health system declaration calls for more cooperation at interdisciplinary, industry, and national levels, and suggests that more attention should be paid to cybersecurity and personal privacy, device interoperability, access to reliable data and information, virtual data repository security, comprehensive analysis and prediction models, and public understanding and ethics issues.

The global insect declines and the potential erosion of vital ecosystem services declaration emphasizes that the global insect population has declined significantly in diversity and quantity, and calls for an active response to be made to deal with the global challenge. It suggests new technologies such as artificial intelligence and environmental DNA analysis could be used for long-term monitoring of insect populations, and adds that science popularization is required to evoke the consensus of the public. Measures should to be taken to protect habitats in crisis that depend on a food chain from insect populations.

The Brazilian Academy of Sciences, the German Academy of Sciences Leopoldina, the French Academy of Sciences, the Korean Academy of Science and Technology, the Royal Society of Canada, the National Academy of Sciences (NAS), the Nigerian Academy of Science, the Science Council of Japan, the Linceorum Academia, the Indian Academy of Sciences, the Indonesian Academy of Sciences, the Royal Society, UK, the Chinese Academy of Sciences and the Global Youth Academy signed the declarations.

Source: Bureau of International Co-operation, Chinese Academy of Sciences

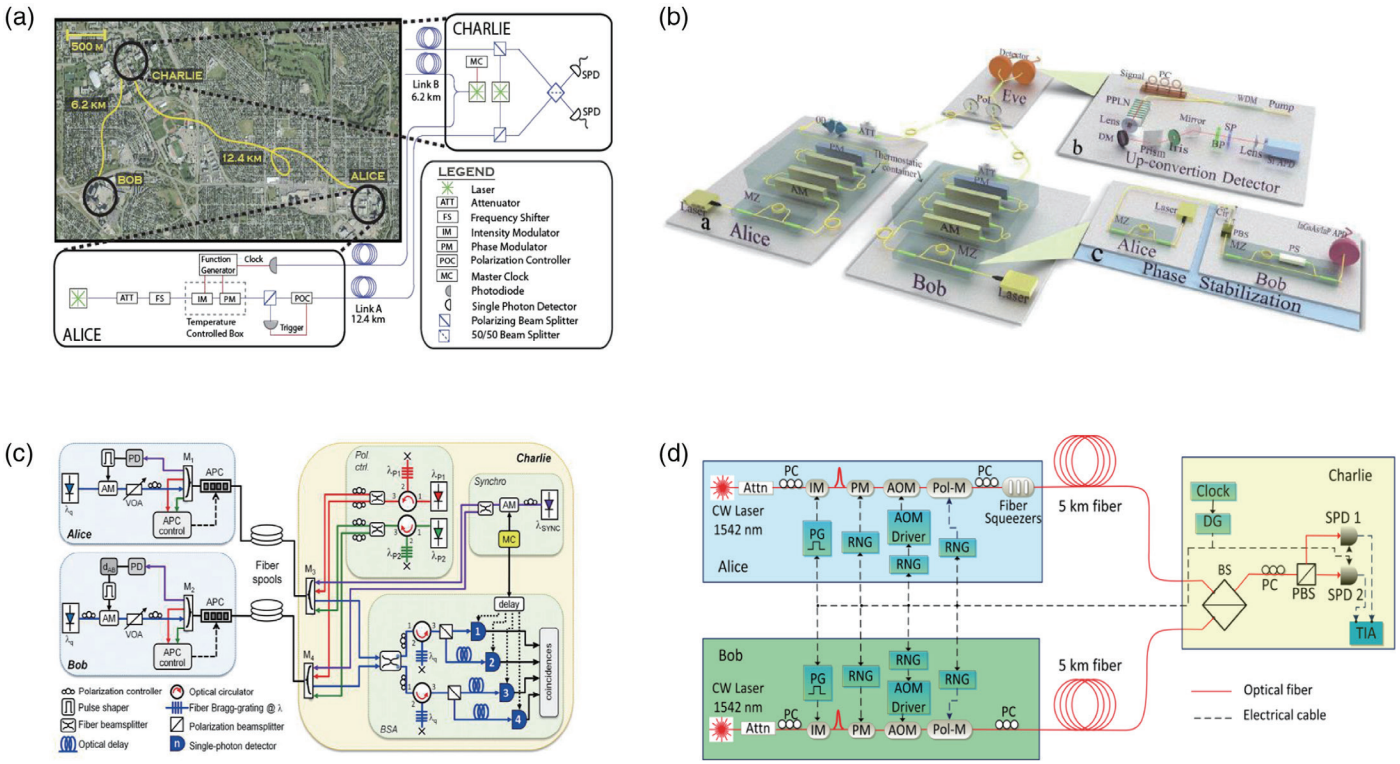


Figure 1. (Color online) The four initial MDI-QKD experiments.
a, Proof-of-principle MDI-QKD with time-bin encoding (Rubenok *et al.*, 2013). b, Full MDI-QKD implementation with random modulations of states and decoy intensities based on time-bin encoding (Liu *et al.*, 2013). c, Proof-of-principle MDI-QKD with polarization encoding (Ferreira da Silva *et al.*, 2013). d, Full MDI-QKD with random modulations of states and decoy intensities based on polarization encoding (Tang *et al.*, 2014b). [Figures reproduced from (Liu *et al.*, 2013; Rubenok et al., 2013; Ferreira da Silva *et al.*, 2013; Tang *et al.*, 2014b)]

A review of quantum secure communication

Professor Pan Jianwei, Professor Xu Feihu and Professor Zhang Qiang from the University of Science and Technology of China (USTC), collaborating with Professor Ma Xiongfeng from Tsinghua University and Professor Hoi-Kwong Lo from the University of Toronto, were invited to publish a review entitled "Secure Quantum Key Distribution with Realistic Devices" in the *Reviews of Modern Physics* on May 26.

Quantum communication is an important branch of quantum information science. It refers to the communication technology that uses quantum bits as information carriers for information transference.

One of the most typical applications of quantum communication is quantum key distribution (QKD). QKD is the only means of communication so far with strictly proved security. It is also the first quantum information technology to move from the laboratory to practical application, and as such is one of the most dynamic frontiers in physics.

In recent years, with the development of practical QKD research, the realistic security of QKD has been of great interest globally. The potential security risks and solutions introduced by devices in actual systems that do not fully conform to the mathematical model of the protocol have been extensively studied. It's worth mentioning that Professor Pan's team experimentally realized several important new protocols for the first time anywhere in the world.

This paper reviews the development history of quantum cryptography in detail, discusses the practical security of quantum key distribution in depth, and forecasts the future development trend of QKD technology. Through more than 30 years of joint efforts by global researchers the security of practical quantum cryptography has been established. In particular, proposed QKD protocols, such as the measurement-device independent (MDI) protocol, remove the security

>> **PAGE 8**

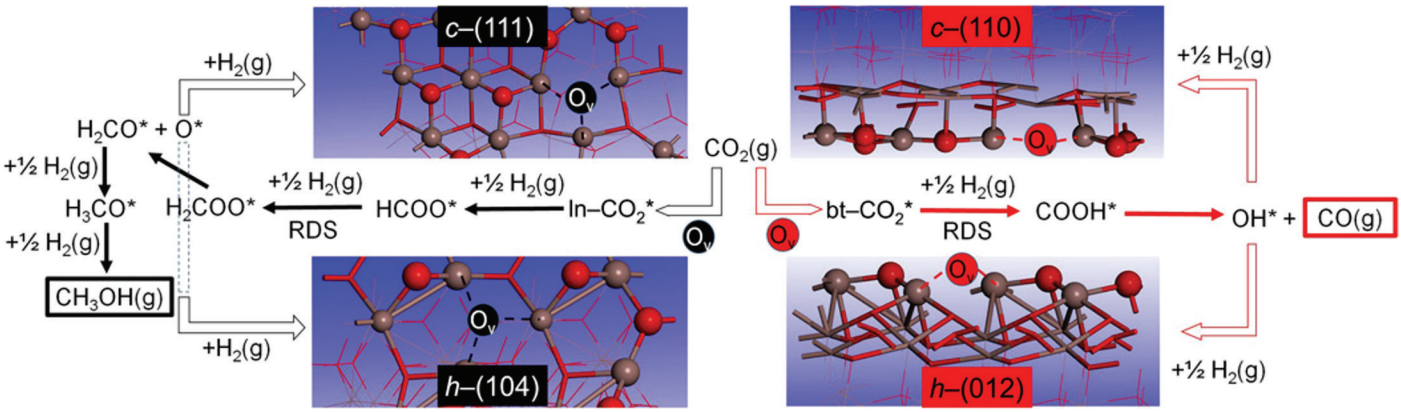


Figure1. Schematic illustration of the most favorable CO_2 hydrogenation pathways on different cubic (c–In_2O_3) and hexagonal indium oxide (c–In_2O_3) surfaces [Figures adapted from *Science Advances*]

Efficient indium oxide catalysts designed for CO_2 hydrogenation to methanol

Catalytic hydrogenation of carbon dioxide (CO_2) is a green and sustainable means of synthesizing commodity chemicals such as methanol. This conversion process is key to realizing the "methanol economy" or creating "liquid sunshine," both aspects of the circular economy. Recent studies revealed the potential for a family of metal oxides to catalyze this reaction. However, further optimizing their catalytic performance for industrial applications remained a great challenge, mostly due to the difficulties related to the need for rational design and controlled synthesis.

A team jointly led by Professors Sun Yuhan, Gao Peng, and Li Shenggang at the Shanghai Advanced Research Institute (SARI) of the Chinese Academy of Sciences took up that challenge, and have reported a successful case of theory-guided rational design of indium oxide (In_2O_3) catalysts for CO_2 hydrogenation to methanol with high activity and selectivity. The new findings were published in the latest issue of *Science Advances* on June 17.

To rationally design In_2O_3-based nanocatalysts with favorable methanol synthesis performance, researchers carried out extensive density functional theory (DFT) calculations to establish the catalytic mechanism of the In_2O_3 catalyst during CO_2 hydrogenation to methanol and carbon dioxide by identifying preferred pathways. The computational modeling identified the rarely studied {104} facet of hexagonal In_2O_3 as the most favorable for methanol synthesis.

On the basis of this theoretical prediction, several experimental methods were then employed to synthesize In_2O_3 catalysts in different phases with distinct morphologies.

Interestingly, one of the four In_2O_3 catalysts synthesized in this way was confirmed to mainly expose the theoretically identified {104} facets. This catalyst also exhibited the best performance in terms of both activity and selectivity, confirming the DFT prediction. The methanol synthesis reaction catalyzed by this catalyst is favorable even at the very high temperature of 360 °C.

The space-time yield of methanol reached 10.9 mmol/g/hour at this temperature, which surpassed that of all previously known catalysts for this reaction, including previously reported In_2O_3-based catalysts and well-known Cu-based catalysts.

The In_2O_3 catalyst discovered in this research is promising as a way of directly converting CO_2 into methanol for industrial applications. In addition, the discovery of this In_2O_3 catalyst will promote the further development of oxide/zeolite bifunctional catalysts for direct CO_2 hydrogenation to various C_{2+} hydrocarbons (lower olefins, gasoline, aromatics and so on) via the methanol intermediate. Just as importantly, this discovery also highlights the pivotal role of computational science in helping to design industrially relevant catalysts.

For more information, please contact:
Prof. Sun Yuhan
Email: sunyh@sari.ac.cn
Shanghai Advanced Research Institute, Chinese Academy of Sciences

Source: Shanghai Advanced Research Institute, Chinese Academy of Sciences

Bringing new crops to China: Yunnan Avocado Co. takes root in Lijiang

Along the banks of the Upper Yangtze River in Yunnan Province, halfway between Dali and Lijiang, there is a place that does not quite fit in with the surrounding landscape. At first, the crystal-clear, teal-colored river, lined by pristine pomegranate, mango, and grape orchards against a striking mountain backdrop might catch your eye. And yet, another unique feature of this place might remain unseen. But if one looks closely, one might spot peculiar new fruits growing on trees nestled in the foothills. In fact, the very farmers responsible for growing these new fruits have largely never purchased or even tasted their products. For, you see, it is here you can find China's first high-tech avocado plantation and agricultural sustainability project.

I first began this venture to introduce new fruit varieties into China after obtaining my PhD from CAS's very own Kunming Institute of Botany. My diverse background working on agricultural projects across multiple countries (including in small enterprises as well as major global seed companies) — coupled with a doctoral specialization in ecosystem services, honey bees, and sustainable crop pollination — has served as a strong foundation for this project. A publication I authored in 2016 entitled "Is China's unparalleled and understudied bee diversity at risk?" (*Biological Conservation*) was the first to highlight the extremely diverse status of Chinese pollinator species and the irreplaceable benefits they deliver to ecosystems. It was also the first of its kind to point out the considerable threats facing pollinators in China.

During the course of my research, I noticed that there were many global fruit varieties underrepresented in China — many of which are pollinator-dependent. With that in mind, I began looking at the factors driving new fruit introductions into China, and compiled a lengthy list of fruits, vegetables, and pulse crops that were underdeveloped relative to other countries in the world. One of the crops of keenest interest was avocados. I found that Chinese growers produce less than 10% of the avocados they consume (most are imported from Central and South America). Upon completion of my PhD, I set my mind to developing a plan to import, grow, and sell across China select crop species — such as high-quality avocado trees — with the potential to thrive in the hot river valley areas of Lijiang. Bringing new avocado varieties and accompanying technology has the potential to help China become self-sufficient in this global commodity market.

Now, three years after launching the venture, I've officially founded the Yunnan Avocado Co., drawing upon the many lessons learned during my PhD program. We have now also established a demonstration orchard for trialing purposes and a brand-new world-class tree nursery. Our enthusiastic team is realizing the dream of introducing new and highly-productive avocado varieties to China, ensuring the banks of the Upper Yangtze River will never be quite the same again.

By Dr. Jonathan Teichroew

USTC Grad School enrolls students through live-streaming

Livestreaming is undoubtedly the highlight of university enrolment this year. For the first time, the Grad School of the University of Science and Technology of China (USTC) used livestreaming to introduce and present its faculty team, research programs, and campus life. Professional third-party agencies were brought in to assist with event planning and coordination. Teachers and students were trained and prepared systematically. Each event gained over 10,000 views and was highly thought of as a new and interactive experience.

Source: USTC Grad School

>> **PAGE 5**

risks that may occur in the physical realization of quantum cryptography and pave the way for quantum cryptography based on real devices.

A special comment published in the journal states that this review gives both sides of the story, combining the current best theory of quantum security and an extensive survey of what makes a quantum cryptosystem safe in practice.

Reviews of Modern Physics is a most authoritative review journal in the field of physics with an average impact factor of over 40 in the past five years. It publishes only about 40 academic papers every year. This is the second review paper published by Professor Pan's team, and is also China's second review paper published in this journal in quantum information science; confirmation that China continues to maintain its international leading position in quantum communication.

Written by Lu Hongyu, edited by Jiang Pengcen, USTC News Center

For more information, please contact:
Prof. Pan Jianwei
E-mail: panjw@ustc.edu.cn

Source: University of Science and Technology of China, Chinese Academy of Sciences