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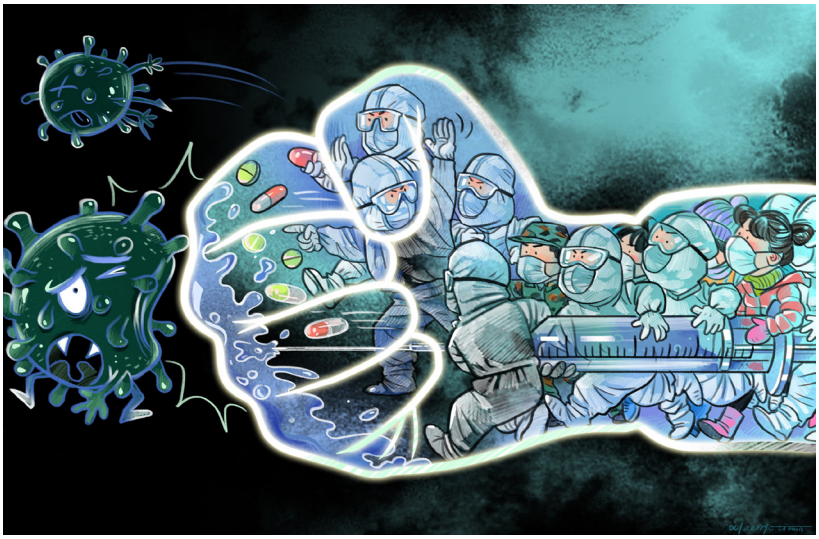
LEAD ARTICLE



[LI MIN / CHINA DAILY]

Research efforts underway in China to hunt down SARS-CoV-2

Efforts to contain the spread of the SARS-CoV-2 have been ramped up in the Chinese scientific community, with researchers racing against time to formulate a detailed profile of the virus and screen potential treatments.

On January 30, the Chinese Academy of Sciences (CAS) announced it would provide Chinese researchers with open and free access to the China Science and Technology Cloud (CSTC) for SARS-CoV-2 research.

The CSTC draws data from the academy's research institutes and major scientific installations, as well as many of China's top universities and private innovation centers.

According to the CAS, Chinese researchers in virus transmission and detection, as well as drug and vaccine development, will have free access to all CSTC resources and services, such as high-performance computing, software and video web conferencing for up to 100 people.

Also on January 30, Baidu Research opened up its RNA structure algorithm LinearFold to gene-testing agencies, epidemic control centers and research institutions around the world.

The SARS-CoV-2 belongs to a group of enveloped, single-stranded RNA viruses. The three-dimensional structure of the virus is critical to its stability and function.

Scientists from Baidu Research said the LinearFold algorithm can

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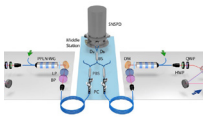
HOT ISSUE

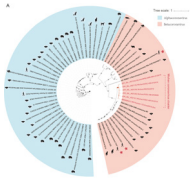
Chinese researchers realize entanglement of two quantum memories by fiber over 50 km



A Chinese research team has realized entanglement of two quantum memories by fiber over 50 km, a breakthrough in the field of quantum communication. >> **PAGE 2**

RESEARCH PROGRESS

SARS-CoV-2 evolution and human transmission mechanism revealed



The SARS-CoV-2 were clustered together in the phylogenetic tree, which belong to the Beta-coronavirus genera (Fig A). It is likely that their natural hosts are bats. They and the SARS/SARS-like coronaviruses shared a common ancestor that resembles the bat coronavirus HKU9-1. >> **PAGE 3**

INTERNATIONAL COOPERATION

QIBEBT deepens cooperation with Chiang Mai University

An international conference on food and applied bioscience was held in Chiang Mai, Thailand, February 6-7. >> **PAGE 6**

SCIENCE STORY

Pakistani professor helps China in battle against SARS-CoV-2

People from all walks of life have united to help contain the deadly disease. Meanwhile, foreigners are also contributing to the fight against the SARS-CoV-2, through financial donations. >> **PAGE 8**

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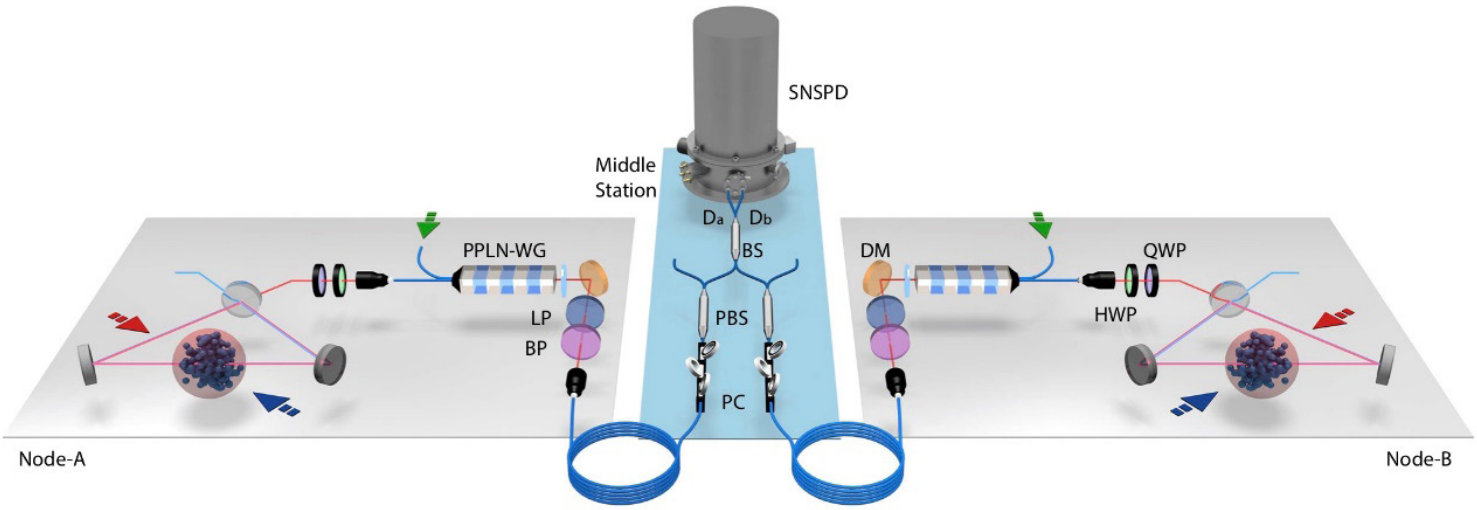


Figure LB-1: Experimental scheme diagram [IMAGE: CAS]

Chinese researchers realize entanglement of two quantum memories by fiber over 50 km

A Chinese research team has realized entanglement of two quantum memories by fiber over 50 km, a breakthrough in the field of quantum communication.

Quantum entanglement is a quantum mechanical phenomenon in which the quantum states of two or more objects are described with reference to each other, even though the individual objects may be spatially separated.

The successful experiment has laid the foundation for the development of a quantum internet that should enable a number of revolutionary applications such as distributed quantum computing.

The experiment was jointly conducted by researchers with the University of Science and Technology of China (USTC), the Jinan Institute of Quantum Technology, and the Shanghai Institute of Microsystem and Information Technology of the Chinese Academy of Sciences.

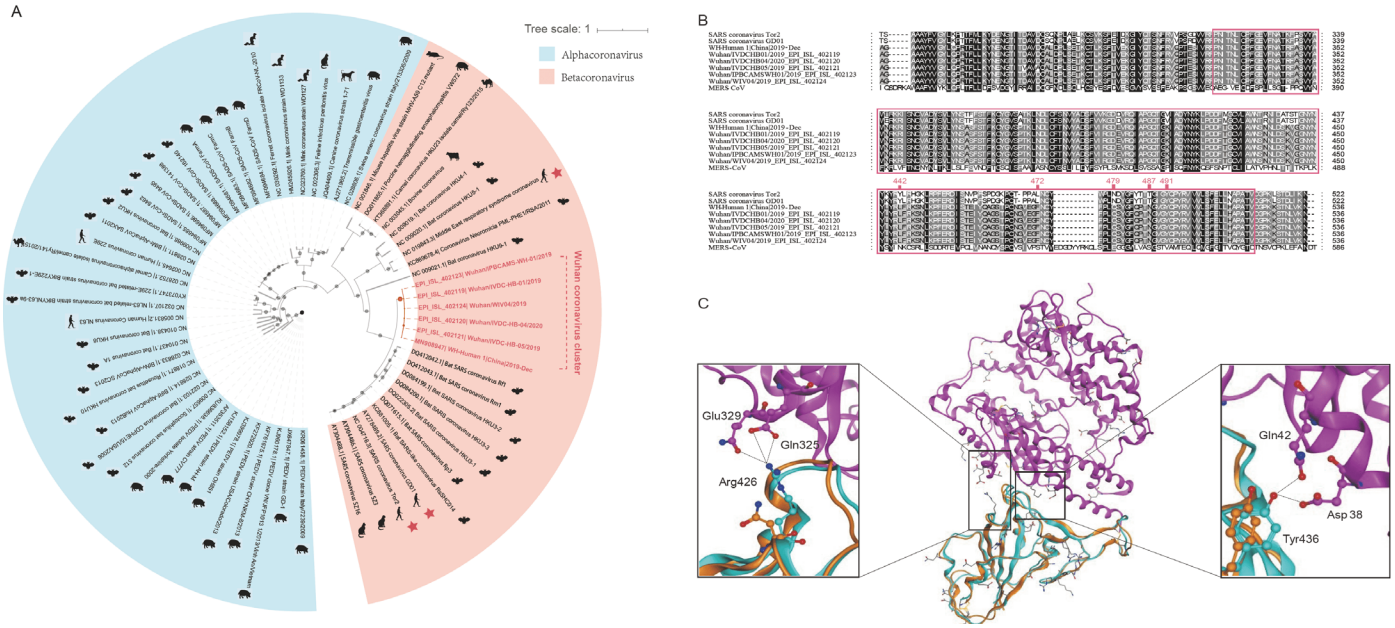
The USTC researchers involved in the experiment included Pan Jianwei, often dubbed the "Father of Quantum" in China, Bao Xiaohui, and Zhang Qiang.

"Despite enormous progress, at present the maximal physical separation achieved between two nodes is 1.3 km, and challenges for longer distances remain," the researchers wrote in a paper published on February 12 in the journal *Nature*. "Our experiment could be extended to nodes physically separated by similar distances, which would thus form a functional segment of the atomic quantum network, paving the way towards establishing atomic entanglement over many nodes and over much longer distances."

The researchers succeeded in the experiment by using cavity enhancement to efficiently create atom-photon entanglement and quantum frequency conversion to shift the atomic wavelength to telecommunication wavelengths, according to the paper.

"These are certainly outstanding results, and steps forward for the work that needs to be carried out to implement quantum repeaters," said a reviewer of *Nature* of the research results. "Bringing the operation of these systems to metropolitan distances is a major advance in the field."

Source: Xinhua



Evolutionary analysis of the coronaviruses and modeling of the SARS-CoV-2 S-protein interacting with human ACE2.
(A) Phylogenetic tree of coronaviruses based on full-length genome sequences;
(B) Amino acid sequence alignment of the RBD domain of coronavirus S-protein;
(C) Structural modeling of the SARS-CoV-2 (WH-human_1 as representative) S-protein complexed with human ACE2 molecule.

SARS-CoV-2 evolution and human transmission mechanism revealed

A research work entitled "Evolution of the Novel Coronavirus from the Ongoing Wuhan Outbreak and Modeling of Its Spike Protein for Risk of Human Transmission" was published online in *SCIENCE CHINA Life Sciences* on January 21, 2020. Doctor Hao Pei (Institut Pasteur of Shanghai, CAS), Doctor Zhong Wu (Beijing Institute of Pharmacology and Toxicology), and Doctor Li Xuan (CAS Center for Excellence in Molecular Plant Sciences, CAS) are co-correspondence authors of this paper. Xu Xintian, Chen Ping, and Wang Jingfang are the co-first authors.

The occurrence of concentrated pneumonia cases in Wuhan City, Hubei Province, China was first reported on December 30, 2019 by the Wuhan Municipal Health Commission. The pneumonia cases were found to be linked to a large seafood and animal market in Wuhan. The Center for Disease Control and Prevention (CDC) and Chinese health authorities later determined and announced that a novel coronavirus, denoted as SARS-CoV-2, had caused the pneumonia outbreak. The current public health emergency partially resembles the emergence of the SARS outbreak in Southern China in 2002. Both happened in winter, with initial cases linked to exposure to live animals sold at animal markets, and both were caused by previously unknown coronaviruses.

The first genome sequence of the SARS-CoV-2 was released on January 10, 2020, and subsequently multiple additional SARS-CoV-2 genome sequences were released. To understand the origin of the SARS-CoV-2 and its genetic relationship with other coronaviruses, the authors performed phylogenetic analysis on the collection of coronavirus sequences from various sources. The results showed the SARS-CoV-2 were clustered together in the phylogenetic tree, which belong to the Betacoronavirus genera (Fig A). It is likely that their natural hosts are bats. They and the SARS/SARS-like coronaviruses shared a common ancestor that resembles the bat coronavirus HKU9-1.

To investigate the SARS-CoV-2 and its interaction with its hosts, the authors looked into the RBD domain of the spike protein (S-protein) of the SARS-CoV-2, which had several patches of sequences with a high homology to that of SARS-CoV_Tor2 and HP03-GZ01 (Fig B). The residues at positions 442, 472, 479, 487 and 491 in SARS-CoV S-protein were

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reported to be at receptor complex interface and considered critical for cross-species and human-to-human transmission of SARS-CoV. However, four of the five critical residues are not preserved except Tyr491 in S-protein of the SARS-CoV-2.

To assess the risk of human transmission of the SARS-CoV-2, the authors performed structural modeling of its S-protein and evaluated its ability to interact with human ACE2 molecules. The computational model of the SARS-CoV-2 S-protein showed a Cα RMSD of 1.45 Å on the RBD domain compared to the SARS-CoV S-protein structure (Fig C). The binding free energy between the SARS-CoV-2 S-protein and human ACE2 was -50.6 kcal/mol, whereas that between SARS-CoV S-protein and ACE2 was -78.6 kcal/mol. Our result points to the important discovery that the RBD domain of the SARS-CoV-2 S-protein supports strong interaction with human ACE2 molecules despite its sequence diversity with SARS-CoV S-protein. Thus the SARS-CoV-2 poses a significant public health risk for human transmission via the S-protein - ACE2 binding pathway.

The article "Evolution of the Novel Coronavirus from the Ongoing Wuhan Outbreak and Modeling of Its Spike Protein for Risk of Human Transmission" gave evidence of the possibility of human transmission of the current SARS-CoV-2 and subsequent public health risk. The authors hope these joint results will contribute to the common good of all people and all parties involved.

This work was supported in part by grants from the National Science and Technology Major Projects for "Major New Drugs Innovation and Development" (directed by Doctor Li Song) (2018ZX09711003) of China, the National Key R&D Program (2018YFC0310600) of China, the National Natural Science Foundation of China (31771412), and Special Fund for strategic bio-resources from Chinese Academy of Sciences (ZSYS-014). The authors also acknowledge the National Institute for Viral Disease Control and Prevention, China CDC; Wuhan Institute of Virology, Chinese Academy of Sciences; Institute of Pathogen Biology, Chinese Academy of Medical Sciences & Peking Union Medical College; and Wuhan Jinyintan Hospital for their efforts in research and collecting the data and genome sequencing sharing.

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Source: Institut Pasteur of Shanghai, Chinese Academy of Sciences

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>> **PAGE 1**

shorten the time for predicting the secondary structure of SARS-CoV-2 from 55 minutes to 27 seconds, speeding up the process of understanding the virus and screening compounds to treat the disease.

Sun Xuejun, a researcher from the Second Military Medical University, said that a major strategy when developing a new antiviral drug is to look for inhibitors for virus replication.

The search can be carried out through testing current broad-spectrum antiviral drugs and screening possible therapeutic compounds in databases.

On January 26, researchers from Shanghai Tech University revealed the high-resolution crystal structure of the viral main proteinase, which controls the activities of the COVID-19 replication complex and is taken as a potential target for therapy.

The researchers screened marketed drugs as well as databases for high potency compounds and for compounds from medicinal plants.

A total of 30 candidates were selected, 12 of which are anti-HIV drugs.

On January 29, Shenzhen health officials announced that the city had launched clinical trials for the anti-HIV drug Aluvia and broad-spectrum antiviral drug Favipiravir, to test their effects on SARS-CoV-2.

Sun also pointed out that another approach could be blocking the receptor on the host cell surface.

Previous studies found that ACE2 is a type of enzyme receptor for the SARS coronavirus (SARS-CoV). It is expressed in the outer layer tissue of human airways and functional tissue in the lungs.

In early January, Chinese researchers found that the ACE2 receptor also plays a key role in SARS-CoV-2's interaction with human cells.

Targeting the ACE2 receptor, researchers from Peking University said they have selected several candidates for treating SARS-CoV-2 by screening 2,674 medicines in the market and 1,500 herbal extracts.

Ammonia bromine, known as Mucosolvan, a respiratory lubrication phlegm medicine that is commonly used in acute and chronic bronchitis, is among the selected candidates. The researchers said they planned to start testing the candidate medicines at molecular levels as soon as possible.

Source: Xinhua

Crossover from two-dimensional to three-dimensional superconducting states in bismuth-based cuprate superconductor

To decipher the mechanism of high temperature superconductivity, it is important to know how the superconducting pairing emerges from the unusual normal states of cuprate superconductors, including pseudogap, anomalous Fermi liquid and strange metal (SM). A long-standing issue under debate is how the superconducting pairing is formed and condensed in the SM phase, because the superconducting transition temperature is the highest in this phase. Although a lot of theoretical progress on the superconducting mechanism of these high-TC superconductors has been made, a unified understanding on how the SC state connects with these unusual normal states is still lacking. Because the SM state of the optimally-doped superconductor not only can develop the SC state with the highest TC but also links the PG and the anomalous FL states, it is of great interest to take the SM state as a breakthrough point to further reveal the underlying physics of cuprate superconductors.

Recently, a team led by Professor Sun Liling at the Institute of Physics (IOP), Chinese Academy of Sciences, chose the optimally-doped $Bi_2Sr_2CaCu_2O8_{+\delta}$ (Bi-2212) single crystal, a typical nearly-two-dimensional high-Tc superconductor with the SM normal state, and widely studied in recent years, as the investigated material. They performed high pressure studies on these samples through state-of-the-art in-situ high-pressure measurements of resistance, magneto-resistance and magnetic susceptibility and discovered a pressure-induced crossover from two- to three-dimensional superconducting states in the optimally-doped $Bi_2Sr_2CaCu_2O8_{+\delta}$ bulk superconductor at a pressure above 2.8 GPa. They found that the two-dimensional (2D) superconductivity bridges the SM state and 3D superconducting state and that the two-dimensional (2D) superconducting transition exhibits a Berezinski-Kosterlitz-Thouless-like behavior. These results provide direct and strong evidence that the SM state is predominantly 2D-like.

In this study, they were the first to perform the combined in-situ high-pressure measurements of AC susceptibility and resistance for the same sample in the same diamond anvil cell. This kind of measurement is a technical challenge because integrating the standard four-probes for the resistance measurement and the coils for the AC susceptibility measurements into the same pressure cell is very difficult, indicating that the high pressure technique adopted in this study is among the highest-level techniques in the world.

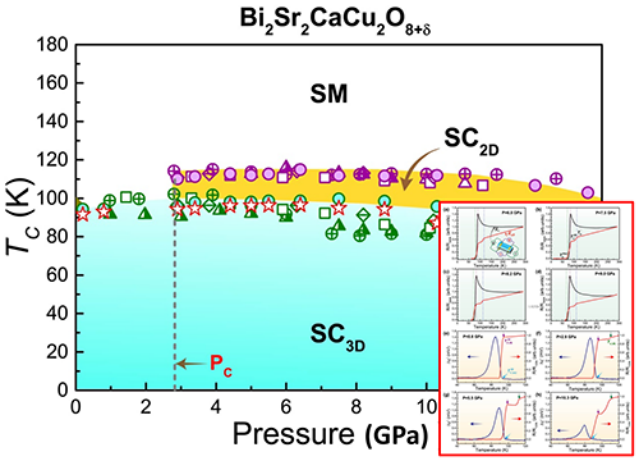

Figure 1: Pressure-TC phase diagram of optimally-doped $Bi_2Sr_2CaCu_2O8_{+\delta}$. The acronyms of SC_{2D} and SC_{3D} stand for 2D (BKT-like) and 3D superconducting states, respectively. SM represents strange metal state. PC represents the critical pressure above which the 2D superconductivity emerges from the SM state. The lower right panel of the figure (a)-(d) show Rab(T) and Rc(T) measured at different pressures, while the figure (e)-(h) display $\Delta\chi'$(T) and R/R120K at different pressures. The purple and green arrows indicate the TC3D and TC', the cyan arrow indicates the TC3D probed by the AC susceptibility measurements.

The high-quality single crystals investigated in this study were provided by Genda Gu from Brookhaven National Laboratory, USA, whose samples of Bi-2212 have been widely studied using other methods. High pressure X-ray diffraction measurements were performed at 15U beamline at the Shanghai Synchrotron Facilities.

These results have been published on *Nature Physics*. Guo Jing, Zhou Yazhou and Huang Cheng are the first co-authors (https://www.nature.com/articles/s41567-019-0740-0.pdf).

The study was supported by the National Science Foundation, the Ministry of Science and Technology of China, the Chinese Academy of Sciences and grants from the US.

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Source: Institute of Physics, Chinese Academy of Sciences

QIBEBT deepens cooperation with Chiang Mai University

An international conference on food and applied bioscience was held in Chiang Mai, Thailand, February 6-7.

The conference, hosted by Chiang Mai University and Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT) of the Chinese Academy of Sciences, offered an opportunity for scholars, technicians and graduate students to communicate on developments in food science and biotechnology.

Six experts from New Zealand, Croatia, Singapore, and Malaysia were invited to make keynote speeches to more than 300 attendees during the two-day event.

The event was one of the cooperation projects of the green biotechnology center, which was built by the two host parties. It aimed to further expand their communication and deepen cooperation in green biotechnology.

The institute and the university have undertaken two research projects supported by the governments of their respective countries, conducted frequent exchanges of young scientific and technological talents and offered training programs for graduate students since the signing of the framework cooperation agreement in 2014 and the joint establishment of the green biotechnology center in 2018.

Thailand has abundant biomass resources, especially of oil and waste, and QIBEBT's main research focuses on high value utilization of biomass resources.

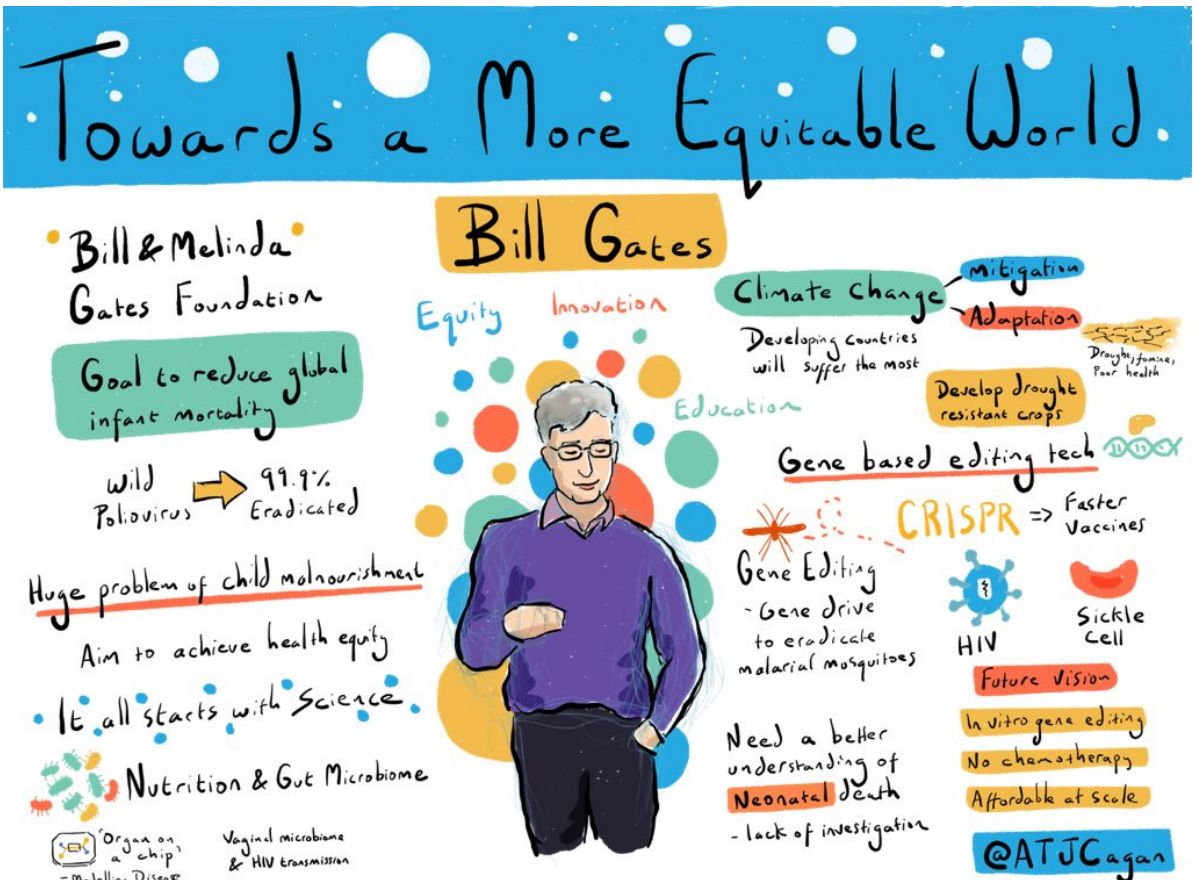
With the support of Thai parties, the QIBEBT has built a 100-ton cellulosic ethanol-medium scale plot system and China's largest production line of microalgae astaxanthin, an example of outstanding cooperation between the institute and its partners in Thailand.

The two projects will also help the institute promote its technologies in the countries and regions involved in the Belt and Road Initiative.

The QIBEBT signs a cooperation agreement with Chiang Mai University to build the green biotechnology center in November 2018 in Qingdao, Shandong province. [IMAGE: QINGDAO INSTITUTE OF BIOENERGY AND BIOPROCESS TECHNOLOGY (QIBEBT), CHINESE ACADEMY OF SCIENCES]

Staff members of the QIBEBT and Chiang Mai University discuss the construction of a system producing ethanol from longan sugar in Chiang Mai, Thailand, in 2018. [IMAGE: QINGDAO INSTITUTE OF BIOENERGY AND BIOPROCESS TECHNOLOGY (QIBEBT), CHINESE ACADEMY OF SCIENCES]

Source: Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT), Chinese Academy of Sciences



Bill Gates calls for a more equitable world in an AAAS Annual Meeting plenary address.
[IMAGE: ALEX CAGAN]

Chinese atmospheric scientist speaks by video at AAAS 2020

A recorded video presentation by Professor Yan Zhongwei of the Institute of Atmospheric Physics (IAP) of the Chinese Academy of Sciences was delivered at the 2020 American Association for the Advancement of Science (AAAS) annual meeting in Seattle, USA on February 16, 2020. Yan had to cancel his travel to Seattle one week before the meeting due to the novel coronavirus outbreak in China. About 30 other registrants from China, including 10 PIOs of CAS institutes, were also unable to attend because of travel restrictions.

Although not able make it to the meeting in person, Professor Yan was still proud to remotely attend what was the first scientific session organized by Chinese atmospheric scientists at an AAAS annual meeting. The session, entitled "Climate Change and Climate Extremes: Precipitation and Projections", was proposed by IAP executive Director General Professor Zhou Tianjun in 2019 and approved by the AAAS organizing committee. Zhou invited Doctor Michael Wehner of the Lawrence Berkeley National Laboratory and Professor Albert Klein Tank of the UK Met Office Hadley Centre to join Professor Yan as session panelists.

In the video talk, Yan introduced IAP's research on how the world's most populous regions will be exposed to more record-breaking climate extremes. According to Wehner, who kindly played the video of Yan's talk, "the session was quite successful. In fact one of the attendees specifically asked me to thank Zhongwei for his interesting presentation." Despite the fact that it was the final session of the program, it was well attended. Discussion afterwards focused on climate tipping points, which was also interesting.

In later emails, Wehner and Tank thanked Yan and the IAP for the opportunity. Both felt it was a good chance to get across the message of the impact of climate change to an American audience and the media.

Source: The Institute of Atmospheric Physics, Chinese Academy of Sciences

Pakistani professor helps China in battle against SARS-CoV-2

With the SARS-CoV-2 outbreak spreading across China from its epicenter in Wuhan, Hubei province, prevention work has entered a critical period.

People from all walks of life have united to help contain the deadly disease.

Meanwhile, foreigners are also contributing to the fight against the SARS-CoV-2, through financial donations.

Munawar Iqbal is a Pakistani scientist who conducts accelerator research at the Institute of High Energy Physics, Chinese Academy of Sciences with the sponsorship of CAS President's International Fellowship Initiative (PIFI).

Though he is the only breadwinner in his three-member family, he donated 2,000 yuan ($285.56) to the Red Cross of Hubei province to assist in epidemic prevention and control in the province.

His 9-year-old daughter Zoha Munawar also expressed her best wishes to people in epidemic-stricken areas and her support to the Chinese people in winning the anti-virus fight, through a video clip.

The clip has been publicized by the Yangshipin, a new media app created by China Media Group.

We interviewed Doctor Iqbal online about his donation.

[IMAGE: THE INSTITUTE OF HIGH ENERGY PHYSICS, CHINESE ACADEMY OF SCIENCES]

Reporter: **Why did you want to donate?**

Dr. Iqbal: It is really a little support. I feel it is my moral duty to help the people of Wuhan in this hour of difficulty.

Reporter: **Regarding the current situation, China is still facing grave and unimaginable difficulties. Have you planned to leave China with your family members due to health and safety considerations?**

Dr. Iqbal: Not at all. China is a safe and secure country. Myself and my family are very safe here. The Chinese government is taking excellent measures to control the disease — measures which are unprecedented and could not be taken by any other government in the world. Just look at the miracle of building two specialized hospitals in 10 days in Hubei to control the disease. China will overcome this disease in a couple of weeks. We have to stand strong and provide moral help to China.

Reporter: **Have there been any similar public health issues in your country? How did your government deal with it?**

Dr. Iqbal: In Pakistan, we have had no problem like this. But we have no capability and capacity to deal with this kind of epidemic like China does.

Reporter: **What do you want to tell other foreigners in China?**

Dr. Iqbal: I want to tell foreigners in China and abroad to please believe in the capabilities of China. Do not discriminate against Chinese people. The Chinese are great and very loving. They only need love and moral support during this difficult time — which is going to come to an end very soon.

A mountain separates China and Pakistan, but people in the two countries have forged a brotherly friendship. China and Pakistan have shared weal and woe and stuck together through thick and thin, with disasters like the Wenchuan Earthquake in 2008 and the floods in Pakistan in 2010. With the efforts and support of people of all ethnic groups in China and all countries in the world, China will surely win the battle against the epidemic.

Source: The Institute of High Energy Physics, Chinese Academy of Sciences

Members from the World Health Organization and other relevant international experts will arrive in Beijing on February 16. [IMAGE: XINHUA]

Chinese scientists working with international peers on virus vaccine

Chinese scientists are actively communicating and engaging with their international peers in finding vaccine and cure for COVID-19, experts said on February 15.

Members from the World Health Organization and other relevant international experts will arrive in Beijing on February 16 to meet and conduct surveys with Chinese scientists and jointly formulate suggestions to combat the epidemic in China and around the world, according to the National Health Commission.

The foreign experts will conduct in-depth exchanges with relevant government bodies involved in the joint prevention and control mechanism of the State Council for the SARS-CoV-2 outbreak, Mi Feng, spokesman for the commission, said at a news briefing on February 15.

In addition, the team will also visit three provinces and selected cities, as well as relevant scientific institutions, to learn about current research on the virus and the effects of China's epidemic control in both urban and rural areas, he said.

"The virus knows no borders, and this epidemic is not just a challenge for China but also for humanity as a whole," Wu Yuanbin, the head of the bureau of science and technology for social development under the Ministry of Science and Technology, said at the news briefing.

"Since the start of the viral outbreak, many countries have joined forces with China in tackling the challenge," he said. In early January, Chinese scientists have isolated and identified the complete genetic sequence of the coronavirus and later shared it with the WHO and rest of the world.

This provided conditions for the international scientific community to begin researching the pathogen, and help to create diagnosis kits, medications and vaccines, he said.

In January, WHO Director-General Tedros Adhanom Ghebreyesus praised China for identifying the pathogen and sharing the sequence, as well as the swift and sweeping responses to tackling the viral outbreak on a national scale.

Wu said experts from Germany and Russia have stayed in touch with their Chinese peers and both sides shared valuable experiences and practices, including knowledge on developing drugs and vaccines, as well as how to treat seriously ill patients.

"We are very grateful for the help (from foreign experts and businesses), and we are willing to maintain an open attitude to conduct exchanges and cooperation with the international community to jointly tackle the epidemic," Wu said.

Source: China Daily

Some coronavirus vaccine varieties undergoing animal testing

China has put some varieties of the vaccine for the SARS-CoV-2 into animal tests as researchers are making their utmost efforts to shorten the development time period, a senior official with the Ministry of Science and Technology said on February 15.

Zhang Xinmin, Head of the China National Center for Biotechnology Development with the Ministry, said China strives to promote international cooperation in the vaccine development and domestic research teams are progressing basically in parallel with their foreign counterparts.

However, he stressed that it must be understood that as a product to be used by healthy people, safety should always be the priority for vaccine development, rather than the development speed.

"Researchers need to be given enough time to develop safe and effective vaccines because their research and development have to follow scientific rules and strict management standards," Zhang said at a news conference in Beijing.

The press conference of the Joint Prevention and Control Mechanism of the State Council is held in Beijing on February 9. [IMAGE: CHINA DAILY]

He said the SARS-CoV-2 is a new pathogen, so the research and development of a vaccine is complex and needs time. To speed up the process, China has formed joint research teams, and they are testing different varieties of vaccines to improve the success rate.

Source: China Daily

Company donates robots and smart medical equipment to Shenyang

Shenyang-based Siasun Robot and Automation Company donated 31 robots and smart medical ancillary equipment for the fight against the COVID-19 in Shenyang, Capital of Northeast China's Liaoning province, on February 5.

The donation, valued at 6.1 million yuan ($872,775) includes seven medical distribution robots, 14 catering service robots and 10 smart nursing beds.

Medical distribution robots and smart nursing beds have been sent to the First Affiliated Hospital with China Medical University in Shenyang for nursing and treatment of COVID-19 patients and suspected cases.

"The equipment will play an important role in the daily care of patients and drug distribution," said Teng Weiyu, deputy director of the hospital. "The robots can reduce the frequency of contact between people, which is of great significance in preventing the transmission of the virus in the hospital."

Shenyang-based Siasun Robot and Automation Co donated a total of 31 robots and smart medical ancillary equipment for the fight against the COVID-19 in Shenyang, capital of Northeast China's Liaoning province, on February 5, 2020. [IMAGE: CHINA DAILY]

The catering service robots have been sent to 14 hotels for receiving tourists from affected areas, service and food distribution, which can help prevent the spread of the pathogen via personal contact.

According to the company, the robots have facial recognition capabilities and voice recognition, and can perform well in reception tasks.

Source: China Daily