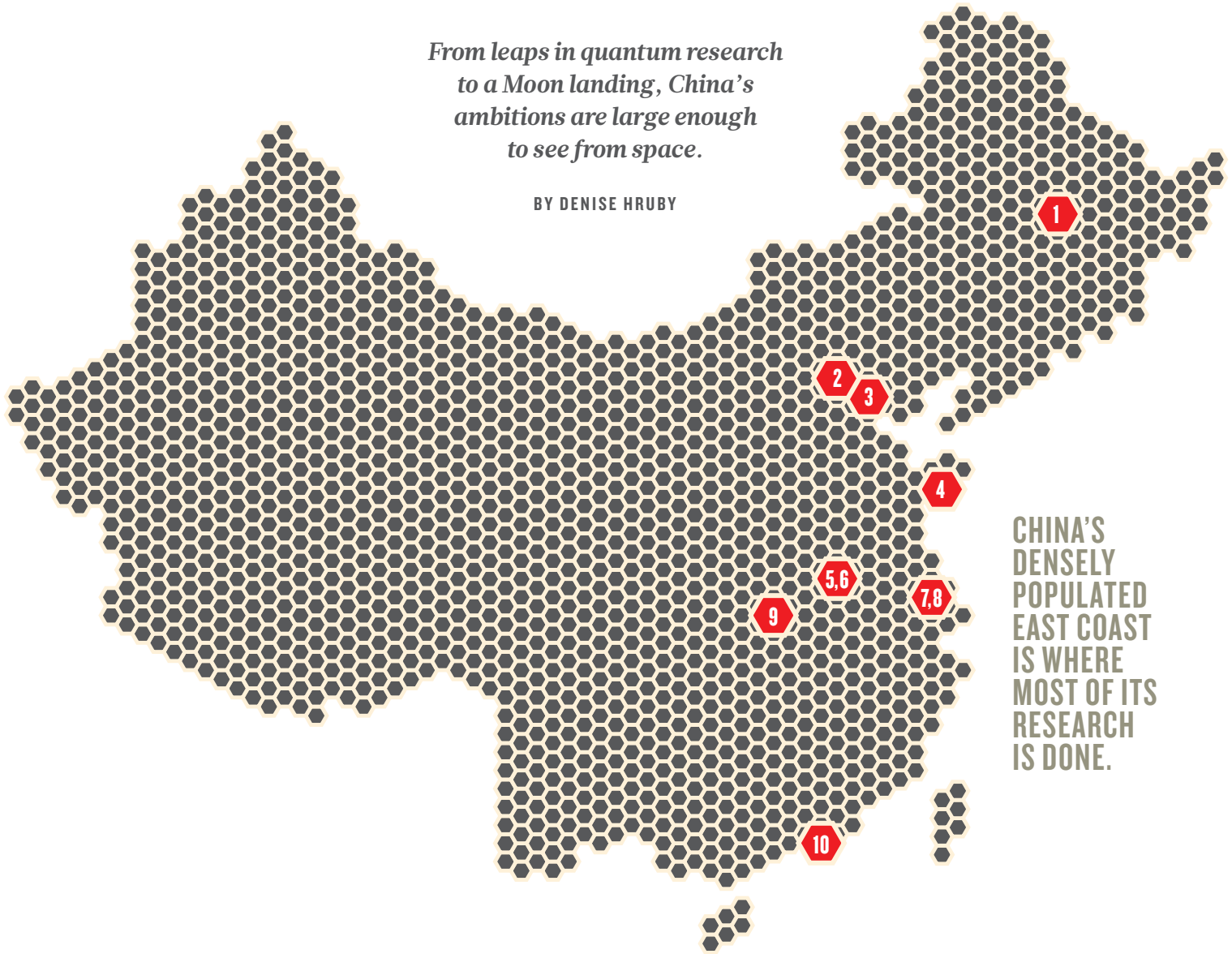


PUTTING SCIENCE ON THE MAP

From leaps in quantum research to a Moon landing, China's ambitions are large enough to see from space.

BY DENISE HRUBY



CHINA'S
DENSELY
POPULATED
EAST COAST
IS WHERE
MOST OF ITS
RESEARCH
IS DONE.

When it comes to China's biggest achievements in science in recent years, many are quick to point to the world's first quantum-communication satellite. Launched in 2016, the spacecraft has already enabled researchers to prove quantum principles that could enable an unhackable communications network.

It's one of many visionary and large-scale

research projects that China has launched with the aim of becoming a science and technology global leader by 2049, the centenary of the founding of the People's Republic of China.

According to research published in June last year, the satellite sent two entangled photons from space to ground stations more than 1,200 kilometres apart, as part of China's two-year Quantum Experiments at Space Scale (QUESS) mission, also called Micius after

the ancient Chinese philosopher. The results demonstrated that the photons remained linked, providing proof that quantum entanglement can endure great distances. Entangled photons could theoretically serve as the basis for a completely secure communications network that hackers cannot penetrate without detection.

Scientists across the country were involved, from physicists working on the fundamentals at the University of Science and

1 HARBIN INSTITUTE OF TECHNOLOGY

The Harbin Institute of Technology (HIT) is central to China's ambitious space-science programme, which includes the launch of the world's first quantum satellite, the establishment of a space station and a planned expedition to Mars. The team at HIT have worked on technology to propel craft into space using electrical rather than chemical energy. In 2016, China used this technology for the first time on an experimental satellite, Shijian-17.

2 NATIONAL SPACE SCIENCE CENTER

In 2016, Johann-Dietrich Wörner, director general of the European Space Agency in Paris, described China's National Space Science Center (NSSC) as dynamic, innovative and at the forefront of discovery. And Wu Ji, director general of the NSSC, was named one of China's top 10 scientists by *Nature* in 2016. Although China's work in space science began long after the United States or Europe, its achievements are impressive, including a 2013 Moon landing.

3 CANSINO BIOLOGICS

A private research laboratory based in the northern coastal city of Tianjin, CanSino Biologics was started in 2009 by a group of Chinese-Canadians who had spent their careers in high-ranking positions at major pharmaceutical companies before relocating to China. Currently, the company is working on a pneumococcal vaccine as well as common vaccines for meningitis and tuberculosis, and plans to have three vaccines on the market by 2019.

4 QINGDAO NATIONAL LABORATORY FOR MARINE SCIENCE AND TECHNOLOGY

China's first national-level marine science laboratory opened in 2015 in Qingdao. The marine sector in Qingdao — including trade, offshore oil exploration and equipment manufacturing — accounts for more than 20% of the city's gross domestic product. The lab has already made headlines with deep-sea explorations, and opened a joint research facility with scientists in Hobart, Australia.

5 DIVISION OF QUANTUM PHYSICS AND QUANTUM INFORMATION

Located at the University of Science and Technology of China in Hefei and established in 2003, the lab captured international headlines last year when its scientists successfully sent a pair of entangled photons from space to ground stations 1,200 kilometres apart, setting a new record. The team includes Lu Chaoyang, named as one of China's leading science stars in 2016 by *Nature*.

6 NATIONAL LAB FOR AI TECHNOLOGY

Opened in May 2017, the artificial intelligence (AI) lab at the University of Science and Technology of China in Hefei is the first national dedicated facility of its kind. At the time of its inauguration, Wu Feng, the lab's director, said his team would work on better understanding the brain's cognitive mechanisms, among other areas. The lab is also tasked with promoting the domestic development of emerging AI industries, such as robots. Several leading universities and Baidu, the Beijing-based Internet giant, are working closely with the team.

7 INSTITUTE OF NEUROSCIENCE

The Shanghai-based Institute of Neuroscience is at the heart of China's plans for brain science. In 2016, the government prioritized the discipline as part of its latest five-year plan. The focal point of research will be the China Brain Project, a multimillion dollar, 15-year project due to launch by the end of 2017. Scientists will explore how the brain works to develop treatments for neurological diseases and advance research into AI.

8 SHANGHAI SYNCHROTRON RADIATION FACILITY

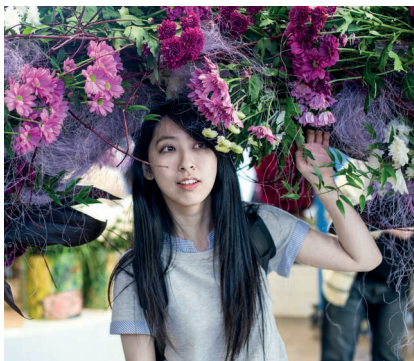
When it opened in 2009, the synchrotron was the most expensive single scientific facility ever built in China: a total of 1.2 billion yuan (US\$176 million at the time) was spent on the intense light generator, putting China into a small club of countries with similar facilities. In 2017, a collaboration between Chinese and Australian scientists at the synchrotron resulted in an algorithm to detect the formation of blood vessels, opening the possibility of detecting cancer much earlier.

9 WUHAN INSTITUTE OF VIROLOGY

The first lab in China to be cleared for high-risk work into the world's most contagious kinds of diseases is based at the Wuhan Institute of Virology in Hubei province, and will focus on researching Ebola. The Wuhan National Biosafety Level 4 Laboratory opened for trial runs in 2015, and in 2017 was approved to handle high-risk pathogens. By 2025, China aims to have at least five labs cleared to work on diseases caused by airborne organisms carrying infections.

10 BGI GENOMICS

This world-leading genomics research centre made its name after sequencing 1% of the human genome as part of an international collaboration. In 2007, the team moved to entrepreneurial tech hub Shenzhen, now home to Internet giant Tencent, tech giant Huawei and DJI, the world's largest drone maker. Analysts predict that BGI will be worth 20 billion yuan by 2020.



Q&A: RETURNEE EXPERIENCE

Materials chemist Yue Hu returned to Wuhan, China, to work at the Huazhong University of Science and Technology (HUST) after completing her PhD at the University of Edinburgh, UK.

BY SARAH O'MEARA

How did you find living in Edinburgh?

The city is small and beautiful, yet it is also a global place. I like the diversity of people who live there. I was surrounded by a lot of intelligent, and super friendly, people from many cultures. Interesting collaborations happened all the time.

Why did you decide to move back to China?

China has developed very fast in recent years and there are a lot of opportunities for young people, especially young researchers. I would love to visit other groups abroad in the future. It's always good to have more collaborators and friends, and to learn from other people.

What differences have you noticed?

People work longer hours in China. In Edinburgh, we were not allowed to go to the lab after 5 pm or during weekends. At HUST, it is very common for students to work from 9 am to 9 pm, and group meetings are regularly held on Saturdays and Sundays. Also, it's cheaper to do experiments in China: the cost of lab materials is generally lower, and there is also more funding available for researchers to buy equipment.

What do you like about living in Wuhan?

I like being close to my family and old friends. It is also in the centre of China, so it's convenient to go other places. Wuhan has many, many universities, which means there are lots of students and it feels very young and dynamic. ■

This interview has been edited for length and clarity.

► Technology of China in the growing science hub of Hefei to those receiving the photons at observatories in the northwest city of Qinghai and southerly city of Lijiang. The project was impressive not just because it could revolutionize the way humans interact, but because it was an entirely Chinese effort. "This research ranges from fundamental science to practical application, and it is a real successful model made in China," said Zhiyong Tang, professor of materials science at the National Center for Nanoscience and Technology in Beijing.

WORLD LEADING

When Micius's results were announced, international physicists recognized that China is becoming a world leader in quantum-satellite technology. A second satellite is already planned, as well as the largest ever quantum research facility, which will, among other research, work on stealth technology for submarines that will make them harder to detect.

Other space-science projects have also made headlines. The unmanned lunar spacecraft Change-3 launched in 2013, and made China only the third country to land on the Moon. And 2016 saw the launch of the nation's most powerful rocket to date, the Long March-7, which will eventually supply China's planned space station. The country also launched its first X-ray telescope last year.

"ONCE YOU DEVELOP THAT REPUTATION, EVERYONE WANTS TO COME. SO THEN YOU GET THE BEST."

In the remote southwestern province of Guizhou, China has finished constructing the world's largest single-dish radio telescope. The half-a-kilometre-wide dish, known as the Five-hundred-meter Aperture Spherical radio Telescope (FAST), was lauded as a unique feat of civil engineering. It is being used to detect radio messages from across the Universe to research phenomena such as dark matter and black holes, as well as listen out for indications of extraterrestrial life.

But China's scientists aren't just interested in what's above. *Jiaolong*, the country's first manned deep-sea submersible, reached a depth of 7,020 metres in 2012, a record for a scientific research vessel. In 2020, it will go on a one-year scientific research mission along the Pacific, Atlantic and Indian Ocean beds.

GRAND SCIENCE DESIGNS

There is every reason to think that China will continue to fund such grand projects for many years to come. Last October, President

ONE APP TO RULE THEM ALL

In China, WeChat reigns supreme. The social messaging platform is used for everything from text chats and games to reading the news, paying bills and ordering taxis.



Xi Jinping told officials at the Communist Party's twice-a-decade national congress that the country must aim to reach new frontiers in science and technology. "We will strengthen basic research in applied sciences, launch major national science and technology projects, and prioritize innovation in key generic technologies, cutting-edge frontier technologies, modern engineering technologies, and disruptive technologies," he was reported as saying by Chinese state media.

In May 2017, the Shenzhen Grubbs Insti-

tute was launched at the Southern University of Science and Technology in Shenzhen. Backed by the Guangdong provincial government, the institute has launched a recruitment blitz to draw the "world's brightest minds". The institute, named after the 2005 Nobel Prize in Chemistry winner Robert H. Grubbs, will focus on the research and commercialization of drugs, materials and clean energy, beginning with plastics and polymers.

Grubbs praised the local infrastructure for rapidly commercializing discoveries in an interview with the state-owned broadcaster China Global Television Network. Reputation was key to attracting talent, he added. "You build a reputation of this department and this campus as really a great place to do science and research. Once you develop that reputation, everyone wants to come. So then you get the best." ■

Denise Hruby is a writer and editor based in Shanghai, China.