A hub for talent

These five science stars are making their mark in China's vast research landscape.

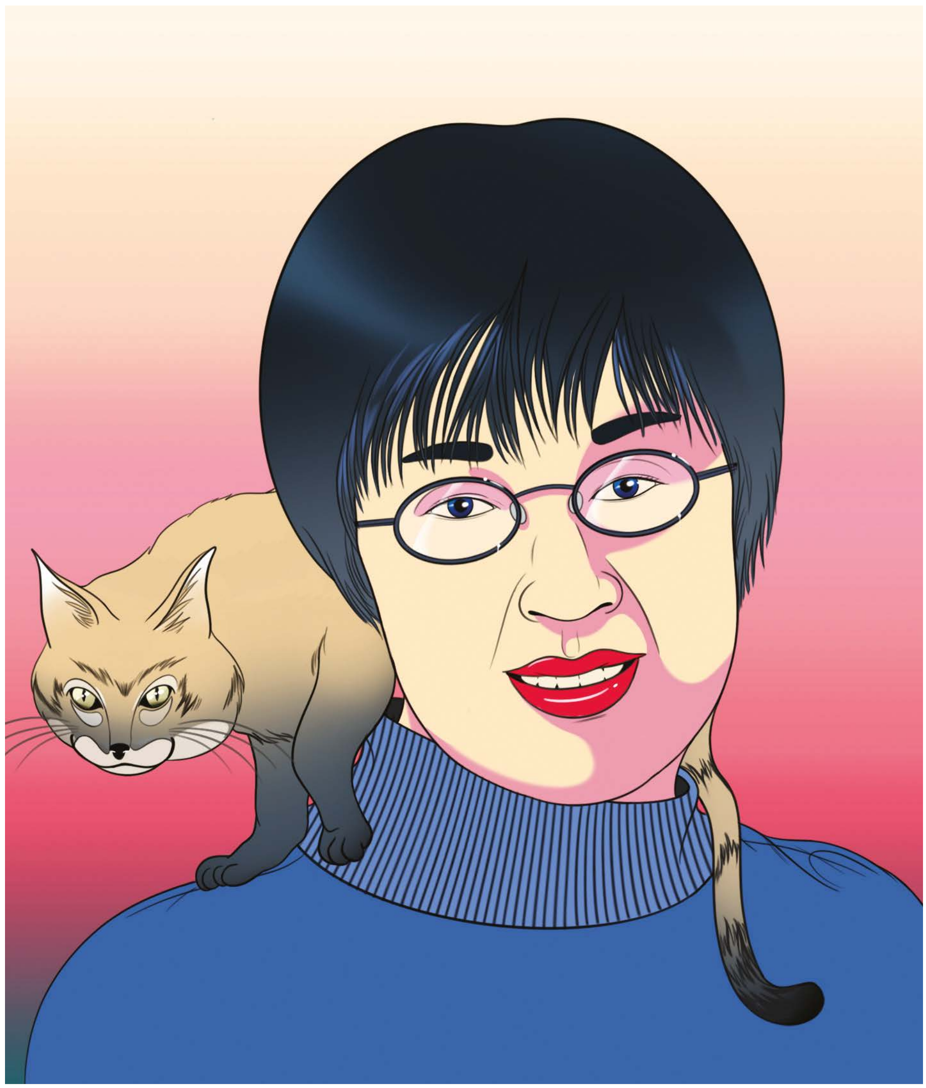
China's push to strengthen its standing in science opens opportunities for exploration. These scientists are driving discoveries in physics, energy, medicine and the natural world.

Panda protector
Lu Zhi

In February, China more than doubled its number of protected species, with 517 additions, including the wolf, large-spotted civet and golden jackal. It was the first update since 1989, and to pioneering conservationist, Lu Zhi, it was a good sign. "I think the government is changing, especially the top leaders, who are sincerely into the environmental issues, not just [related to] wildlife, but also ecosystem restoration and pollution control," she says.

Attitudes towards conservation in China have shifted greatly in recent decades. In the mid-1980s, when Lu was an undergraduate student at Peking University in Beijing, she says the field of conservation biology was not yet recognized in China. Since then, local governments have been designating a growing number of protected areas and the state has announced a 'red line' initiative, which defines limits to human encroachment into ecologically sensitive and vulnerable areas totalling more than 2.4 million square kilometres – roughly one-quarter of the Chinese mainland. Such strategies have great potential. In the Beijing municipality, for example, forest cover has increased from 7% in the 1950s to 43% today, says Lu.

At the same time, the public has become increasingly attuned to the natural world. Since the 1990s, organized bird-watching has become a popular activity on the Chinese mainland, and it feeds valuable data collected by local community groups into population studies. Last year, Lu and her colleagues used data from the Bird Report, the largest nationwide project involving the submission of birdwatching records in China, to simulate changes in the range and habitat of 1,042 bird species through to the year 2070 and identify those most at risk (R. Hu *et al. PLoS ONE* **15**, e0240225; 2020). Although the global trend



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Lu Zhi with a Chinese mountain cat *(Felis bieti)*.

of species loss and habitat destruction is desperate everywhere, says Lu, "in my own life history, in 30 years, I do see positive changes in China and in the world".

As an undergraduate, Lu joined a long-term field study on giant pandas led by biologist Pan Wenshi, tracking wild populations through the high-altitude forests of the Qinling Mountains in northwest China's Shaanxi province. Two decades on, after completing a postdoctoral fellowship in conservation genetics at the US National Institutes of Health, Lu returned to China to run conservation programmes at the wildlife charity WWF and Conservation International. In 2007, she founded the Shan Shui Conservation Centre, in Beijing.

Now a professor of conservation science and executive director of Peking University's Centre for Nature and Society, Lu, whose work with giant pandas has been compared to that of British primatologist Jane Goodall, has studied many of country's most vulnerable mammals, including snow leopards, Himalayan wolves and Chinese mountain cats.

In a paper published in February, Lu and her colleagues argue that China's Wildlife Protection Law does not function as expected and that a permanent ban on wildlife consumption, as well as long-term mechanisms to reduce demand and manage the ban, are needed (L. Xiao *et al. Curr. Biol.* **31**, R168–R172; 2021). In response to the pandemic, which has prompted the World Health Organization to investigate wild-animal trade in China for evidence of animal-to-human disease, China announced new laws temporarily banning the buying and selling of wild-animal products, with permanent changes foreshadowed. **Sian Powell**

Muon maestro
Rustem Ospanov

One scientist, two countries: Rustem Ospanov.

The ATLAS detector at CERN, the European high-energy physics laboratory near Geneva in Switzerland, tracks more than a billion particle collisions every second. Of these, roughly one in a million are flagged as interesting enough for further study.

Rustem Ospanov, a particle physicist at the University of Science and Technology of China (USTC), splits his time between Geneva and Hefei, the capital city of east China's Anhui province. USTC was relocated there in 1970 after being established by the Chinese Academy of Sciences in Beijing 12 years earlier.

Ospanov designs machine-learning algorithms that trawl through vast amounts of data to separate the signals from the background noise. His techniques are being used to measure extremely high-precision interactions between the Higgs boson, a fundamental particle first observed at CERN in 2012, and other particles. "It's not an easy analysis," says Ospanov. "We have to classify these events correctly, as there are background events that look similar."

In 2018, Ospanov's methods helped to provide evidence of the production of the Higgs boson together with a top-quark pair (M. Aaboud *et al. Phys. Rev. D* **97**, 072003; 2018). Roughly 1% of all Higgs bosons are produced via this process, making it the rarest Higgs production mode observed to date.

Higgs bosons decay in one-sextillionth of a second (one-trillionth of a billionth of a second) after they're produced, and the resulting particles are of great interest to physicists. It's estimated, for example, that Higgs boson particles decay into bottom quarks about 58% of the time, whereas just one in five Higgs bosons decay into W bosons, another type of fundamental particle. In a December 2020 preprint, Ospanov and his team describe how an algorithm they developed can separate muons produced by the decay events of W bosons and their 'cousins', Z bosons, from those produced by other events (Atlas Collaboration. Preprint at https://arxiv.org/abs/2012.00578; 2020).

Ospanov's involvement in large physics experiments has propelled him through the ranks as one of the most prolific researchers in China, having been included as a co-author on more than 180 articles in the 82 natural-sciences journals tracked by the Nature Index since 2017. His career has taken him from Russia to the United States – where he moved from the University of Texas at Austin to the University of Pennsylvania in Batavia, Illinois, to join the ATLAS team – and to the University of Manchester, UK.

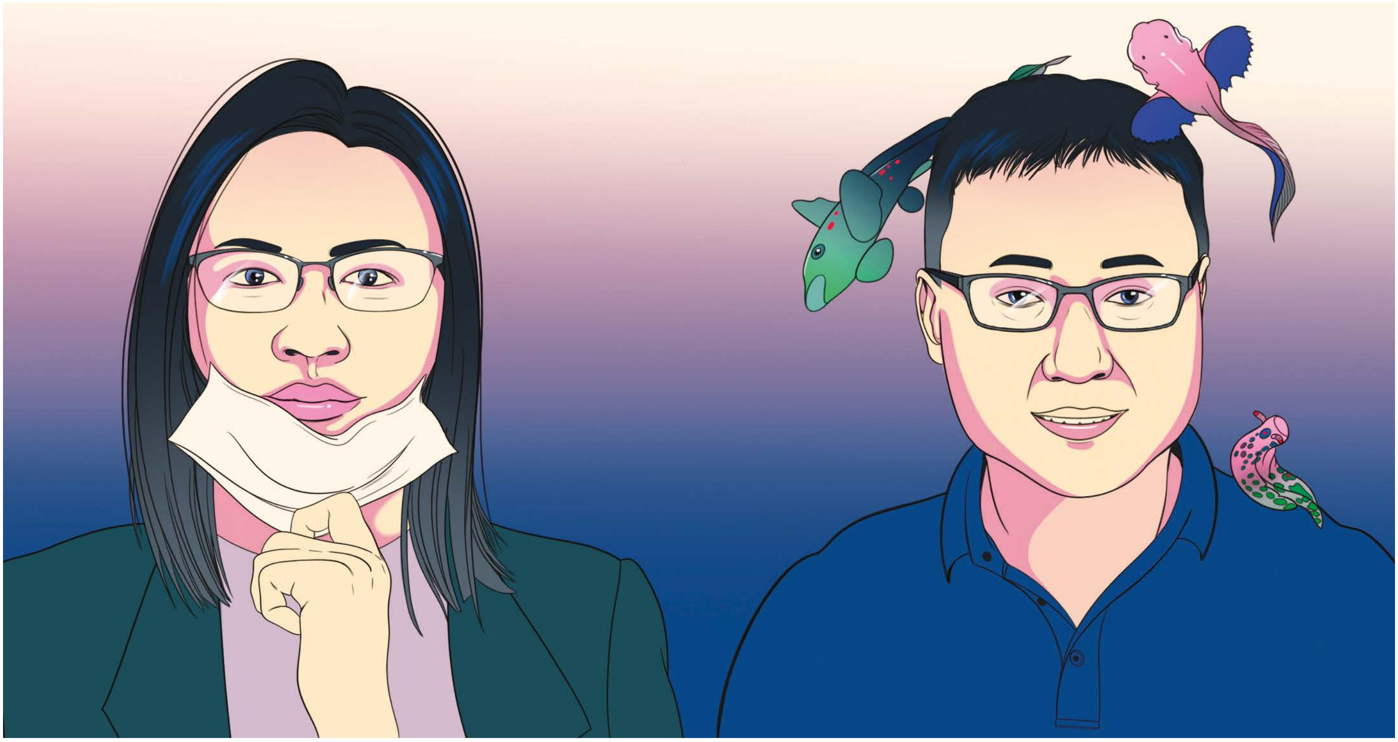
"The ATLAS detector tracks more than a billion particle collisions per second. Roughly one in a million warrants further study."

In 2017, Ospanov took up a research scientist position at USTC, one of China's ten ATLAS-affiliated institutions. The opportunity to split his time between Geneva and Hefei first attracted him to the position, he says, although this mobility has been curbed due to the pandemic. Another advantage of being based at USTC, a relatively young university, is that it attracts some of China's most "highly capable" PhD students and postdoctoral researchers, says Ospanov. In 2019, USTC replaced Peking University, an institution almost twice its age, as the leading Chinese university in the Nature Index. **Gemma Conroy**

Funnel vision
Nancy Hiu Lan Leung

Between 2013 and 2015, Nancy Hiu Lan Leung spent her time as a PhD student in Hong Kong trying to convince patients with cold- and flu-like symptoms to assist with her research by breathing into a giant funnel. Most said no. Leung persisted, interested in whether surgical masks could block the spread of common coronaviruses and rhinoviruses, as well as better-studied influenza strains.

The funnel was part of the Gesundheit-II, a clever but cumbersome apparatus developed at Harvard University in Boston, Massachusetts, to study aerosol spread of influenza. The device is so large it fills a room, and because it has to be disassembled and disinfected after each use, at best Leung could hope to test two volunteers a day. By 2016, her team recruited 246 patients, randomizing who would wear a surgical mask while they breathed into the funnel. Leung meant to write



Common colds and seabed plastics: Nancy Hiu Lan Leung (left) and Xikun Song (right).

up the study, but other work got in the way. Common-cold research is rarely a path to scientific acclaim, says Leung, but her focus on studying the basics of virus–host interactions in the SARS coronavirus drove her interest in the mechanisms of transmission.

The COVID-19 pandemic gave her work new relevance. Leung, who is now a research assistant professor at the University of Hong Kong, and her supervisor-turned-collaborator, Benjamin Cowling, realized that they had evidence that face masks could curb the spread of the viruses that were proliferating worldwide. They dug up their results and called the lab to process the final batch of samples. "We wrote it up pretty quickly," Cowling says of the paper published online in April 2020 with Leung as lead author (N. H. L. Leung *et al. Nature Med.* **26**, 676–680; 2020).

The study, which features contributions from Gesundheit-II pioneers James McDevitt and Donald Milton, is among the most widely discussed papers published during the pandemic, based on Altmetric Attention Score. Leung and Cowling say that in a different year, it may not have been noticed.

Although it did not specifically address SARS-CoV-2 (the coronavirus that causes COVID-19), their work heavily informed public health responses to the new disease, says Raina MacIntyre, an epidemiologist at the University of New South Wales in Australia, who was not involved in the study. "This was one of the first studies that really made people think about the value of universal masking," she says.
Flynn Murphy

Deeply curious
Xikun Song

An estimated 8 million tonnes of plastic enter the ocean each year from coastlines, rivers and other sources, accounting for 80% of global marine debris. Carried by the tides and accumulating in surface waters and on the sea floor, plastic poses a major threat to marine organisms that might ingest or become entangled in it. But for some species, it's become an unlikely hub of breeding and feeding.

"The study is among the most widely discussed during the pandemic. In a different year, it might not have been noticed."

At the State Key Laboratory of Marine and Environmental Science at Xiamen University in China's Fujian province, Xikun Song is investigating the deep-sea lifeforms that gather on discarded plastic. Using the crewed submersible *Shenhai Yongshi* ('Deep sea warrior'), Song and his colleagues collected items including plastic bags, bottles and wrappers from large debris dumps in the Xisha Trough of the South China Sea, some from trenches more than 3,000 metres deep.

Roughly 1,200 organisms from 49 species, including corals and crustaceans, were identified on these items, as well parasitic flatworm and sea snail eggs. The study, published in January, suggests that some deep-sea pollution dumps are functioning as new biodiversity hotspots (X. Song *et al. Environ. Sci. Technol. Lett.* **8**, 148–154; 2021). "It was completely unexpected," says Song.

Song grew up in the city of Jinan, capital of eastern China's Shandong province. In 2016, he completed his PhD at the University of Chinese Academy of Sciences in Beijing on the evolution of small, deep-sea predators called hydroids. Song's research, which investigated hundreds of living and fossil specimens collected by Chinese, American and German expeditions in Arctic and Antarctic locations, was awarded an outstanding postdoctoral fellowship by the State Key Laboratory of Marine Environmental Science at Xiamen University for its multidisciplinary approach combining morphological, molecular and palaeontological data.

Song describes the world's deep sea and polar regions as the "final frontiers in marine and ocean science". In March, China named deep-sea exploration as a priority research area in its latest five-year plan, which sets the nation's social and economic development guidelines.

Among the plan's goals are speeding up the establishment of marine-science institutions, strengthening international research collaborations and increasing spending on technologies such as submersibles – a major asset in China's deep-sea missions.

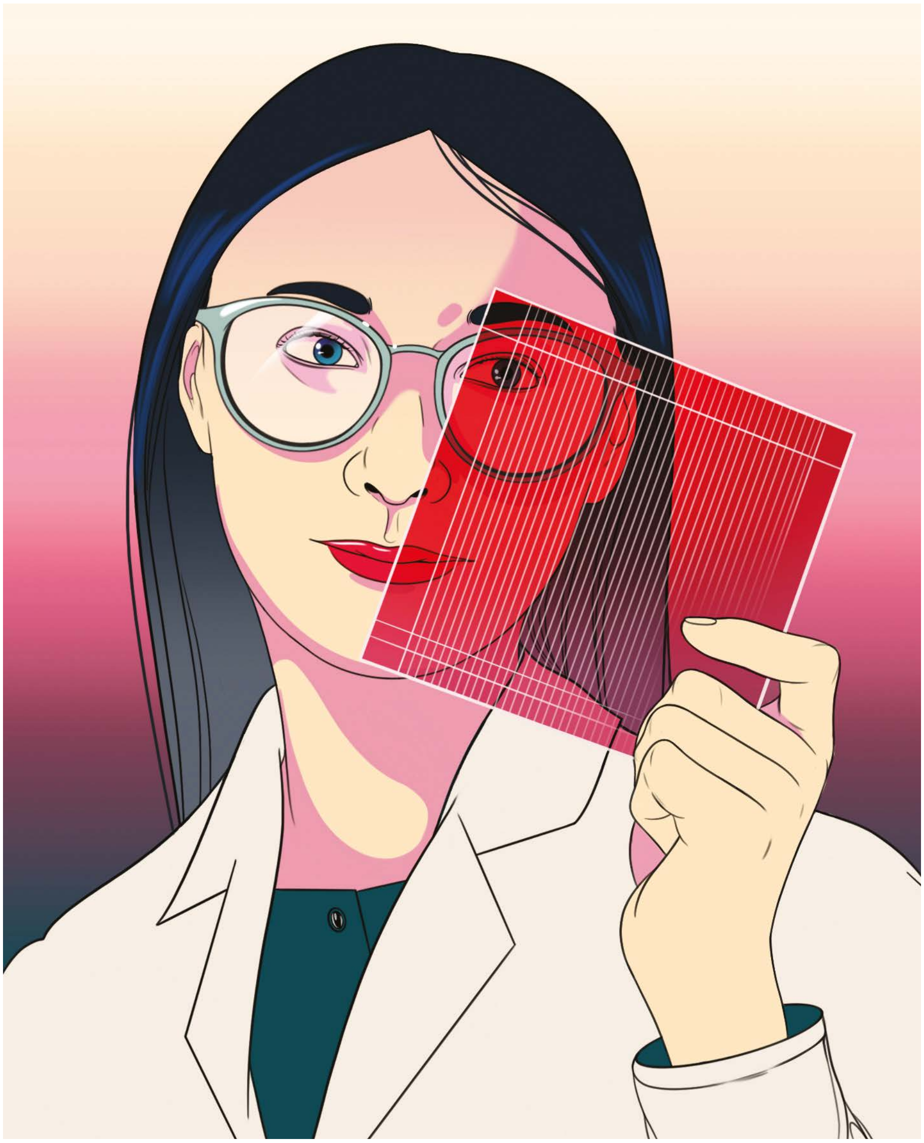
In 2020, China's crewed vessel *Fendouzhe* ('Striver') plunged 10,909 metres to transmit the first live video feed of the deepest point of the Mariana Trench, narrowly missing the 10,927-metre world record set by American explorer Victor Vescovo in 2019.

The submersible has also been used to investigate deep-sea deposits containing nickel, copper, cobalt and manganese, as China readies itself to become the first nation to mine the sea floor once regulations are approved by the UN-backed International Seabed Authority (ISA). The mining code, a ruleset that aims to regulate prospecting, exploration and exploitation of marine minerals in international waters, was set to be finalized by the ISA last year, but the process has been delayed by the pandemic.

As *Nature* reported in 2019, researchers have expressed fears that deep-sea mining could devastate certain species and ecosystems across vast areas due to sediment displacement and other disturbances (see *Nature* **571**, 465–468; 2019). **Gemma Conroy**

Solar star
Qi Jiang

A standout scientist in the global race to boost the performance of solar cells, Qi Jiang is keen to see perovskite solar cells – the fastest-improving solar technology to date – meet their potential.



Qi Jiang's research investigates boosting the performance of solar cells.

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Compared with the silicon cells that dominate the US$160-billion-a-year global solar energy industry, solar cells using perovskite semiconductors are cheaper to manufacture and offer similar light-to-energy conversion efficiency. But they are prone to decay and instability in the harsh conditions that solar cells endure, and the conversion-efficiency rates achieved on small surface areas in laboratories have proved difficult to replicate at scale. Another challenge, says Jiang, is that the highest efficiency perovskite cells include lead, an environmental hazard. "We need to think of ways to prevent leakage and effectively recycle these solar cells."

In 2019, Jiang and her colleagues demonstrated how improvements in power conversion and durability can be gained by the use of a phenethylammonium iodide film on the surface of the perovskite layer within the cell. The paper, with Jiang as lead author, was the most highly cited among articles in the Nature Index with Chinese-affiliated authors that year (Q. Jiang *et al. Nature Photon.* **13**, 460–466; 2019).

Research into perovskite solar cells is drawing widespread attention, particularly in China, which accounts for approximately 80% of the global share of solar-cell manufacturing. In 2019, six of the ten most highly cited articles with significant contributions by Chinese-affiliated authors in the Nature Index were related to solar energy technologies. Four of these papers were focussed on perovskite solar cells. "They are very promising and extremely simple to process in the lab, so many researchers all over the world are getting into this area," says Jiang.

Jiang developed an interest in semiconductors while studying microelectronics at Hubei University in Wuhan, the capital city of central China's Hubei province. She began investigating their potential in solar cells as a PhD and postgraduate researcher at the Chinese Academy of Sciences Institute of Semiconductors in Beijing, and co-authored the highly cited *Nature Photonics* article with colleagues from there and the University of Chinese Academy of Sciences.

In 2018, Jiang moved to the United States, where she continued her research into perovskite cells at the National Renewable Energy Laboratory in Golden, Colorado. It was a valuable opportunity to experience a different research culture, she says. "It allowed me to build my achievements and exercise my independence on research."

Jiang says the global shortage of conventional semiconductors, attributed to pandemic-induced supply-chain disruptions, highlights the importance of developing alternatives for use in energy harvesting. "The raw materials for making perovskite solar cells are very cheap and easy to get," she says. **Sian Powell**

Correction

This story erroneously stated that Lu Zhi and her colleagues had argued in a February paper that recent regulations set by China in response to the outbreak of COVID-19 do not function as expected. In fact, they were referring to pre-existing regulations, set by China's Wildlife Protection Law.