China’s Latest Leap Forward Isn’t Just Great—It’s Quantum

Beijing prepares to launch the world’s first quantum-communications satellite into orbit

0:00 / 0:00

Aboard the Micius satellite is encryption technology that, if successful, could propel China to the forefront of hack-proof communications. Professor Hoi Fung Chau of Hong Kong University explains how quantum physics can be used to frustrate hackers. Photo: CCTV

By JOSH CHIN

Updated Aug. 15, 2016 10:29 a.m. ET

7 COMMENTS

BEIJING—A rocket scheduled to take flight from the Gobi Desert within days is expected to propel China to the forefront of one of science’s most challenging fields.

It also is set to launch Beijing far ahead of its global rivals in the drive to acquire a highly coveted asset in the age of cyberespionage: hack-proof communications.

Chinese state media on Monday said preparations were nearly complete to send the world’s first quantum communications satellite into orbit from a launch center in Inner Mongolia. Five years in the making, the project is being closely watched in global scientific and security circles.

The quantum program is the latest part of China’s multibillion-dollar strategy over the past two decades to draw even with or surpass the West in hard-sciences research.

“There’s been a race to produce a quantum satellite, and it is very likely that China is going to win that race,” said Nicolas Gisin, a professor and quantum physicist at the University of Geneva. “It shows again China’s ability to commit to large and ambitious projects and to realize them.”

Scientists in the U.S., Europe, Japan and elsewhere are rushing to exploit the strange and potentially powerful properties of subatomic particles, but few with as much state support as those in China, researchers say. Quantum technology is a top strategic focus in the country’s five-year economic development plan, released in March.

Beijing hasn't disclosed how much money it has allocated to quantum research or to building the 1,400-pound satellite. But funding for basic research, which includes quantum physics, was $101 billion in 2015, up from $1.9 billion in 2005.

U.S. federal funding for quantum research is about $200 million a year, according to a congressional report in July by a group of science, defense, intelligence and other officials. It said development of quantum science would "enhance U.S. national security," but that said fluctuations in funding had set back progress.

Beijing, meanwhile, has tried to lure Chinese-born, foreign-educated experts in quantum physics back to China, including Pan Jianwei, the physicist who is leading the project.

"We've taken all the good technology from labs around the world, absorbed it and brought it back," Mr. Pan told Chinese state TV in an interview that aired on Monday.

With state support, Mr. Pan was able to leapfrog his former Ph.D. adviser, University of Vienna physicist Anton Zeilinger, who said he has tried since 2001 to convince the European Space Agency to launch a similar satellite.

MORE CHINA COVERAGE

IMF Warns China of Reliance on Credit, Other Imbalances Aug. 13, 2016

China's Gauge of Financial Risk Falls Short Aug. 12, 2016

Steam-Pipe Blast at Chinese Power Station Kills 21 Aug. 11, 2016

After Years of Growth, Beijing Tries to Shrink Aug. 10, 2016

In China, Regional Economic Data Highlights Growing Divide Aug. 10, 2016

"It's a difficult process, which takes a lot of time," said Mr. Zeilinger, who is now working on his former student's satellite.

Neither Mr. Pan nor the Chinese Academy of Sciences, which is directing the project, responded to requests for comment. The European Space Agency and the U.S.'s National Science Foundation,

which provides federal funding for basic American science research, also didn't respond to requests for comment.

China's investment in the field is likely being driven in part by fear of U.S. cyber capabilities, said John Costello, a fellow at Washington, D.C.-based New America specializing in China and cybersecurity, pointing to 2013 disclosures that the U.S. had penetrated deeply into Chinese networks. He also noted that U.S. institutions are researching how to build powerful quantum computers theoretically capable of shattering the math-based encryption now used world-wide for secure communication. "The Chinese government is aware that they are growing particularly susceptible to electronic espionage," Mr. Costello said.

However, quantum communication is defensive in nature, he noted, and wouldn't benefit what the U.S. has identified as China's state-sponsored hacking program.

Quantum encryption is secure against any kind of computing power because information encoded in a quantum particle is destroyed as soon as it is measured. Gregoir Ribordy, co-founder of Geneva-based quantum cryptography firm ID Quantique, likened it to sending a message written on a soap bubble. "If someone tries to intercept it when it's being transmitted, by touching it, they make it burst," he said.

Quantum physicists have recently advanced the use of photons to communicate securely over short distances on earth. The satellite, if successful, would vastly expand the range of unhackable communication.

To test whether quantum communications can take place at a global scale, Mr. Pan has told state media, he and his team will attempt to beam a quantum cryptographic key through space from Beijing to Vienna.

"It would be enormous" if the test succeeded, said Ma Xiaosong, a Vienna-trained quantum physicist at Nanjing University who worked on early phases of the satellite project.

Quantum encryption isn't foolproof. It's possible for hackers to trick an incautious recipient by shining an intense laser into a quantum receptor, said Alexander Ling, principal investigator at the Center for Quantum Technologies in Singapore.

A Long March 2-D rocket with the Dark Matter Particle Explorer satellite on board launched from northwest China on Dec. 17, 2015. China is expected to launch a new rocket carrying a quantum-communications satellite that could propel the country to the forefront of quantum communications. ENLARGE

A Long March 2-D rocket with the Dark Matter Particle Explorer satellite on board launched from northwest China on Dec. 17, 2015. China is expected to launch a new rocket carrying a quantum-communications satellite that could propel the country to the forefront of quantum communications. PHOTO: QU JINGLIANG/EUROPEAN PRESSPHOTO AGENCY

U.S. security experts also question whether intricacies of quantum communication can be simplified enough for use in a conflict situation.

“Inevitably these kinds of technologies have problems and things get messed up by the people using them, unless they have gone through extensive training,” said Peter Mattis, a fellow at the Jamestown Foundation who studies China’s intelligence services.

Whatever the challenges, the University of Vienna’s Mr. Zeilinger said, the satellite puts China and the field of quantum mechanics on the verge of a significant technological breakthrough.

“In the long run, there is a good chance that this will replace our current communications technology,” he said. “I see no basic reason why it won’t happen.”

In a January interview with the journal Nature, Mr. Pan said the satellite showed China’s scientists had stopped following in the footsteps of others. To drive the point home, Chinese state media on Monday said the satellite had been named Micius after a 5th century B.C. philosopher who opposed offensive warfare.

“I think China has an obligation not just to do something for ourselves—many other countries have been to the moon, have done manned spaceflight—but to explore something unknown,” he said.

— Vivian Pang contributed to this article.

Write to Josh Chin at josh.chin@wsj.com