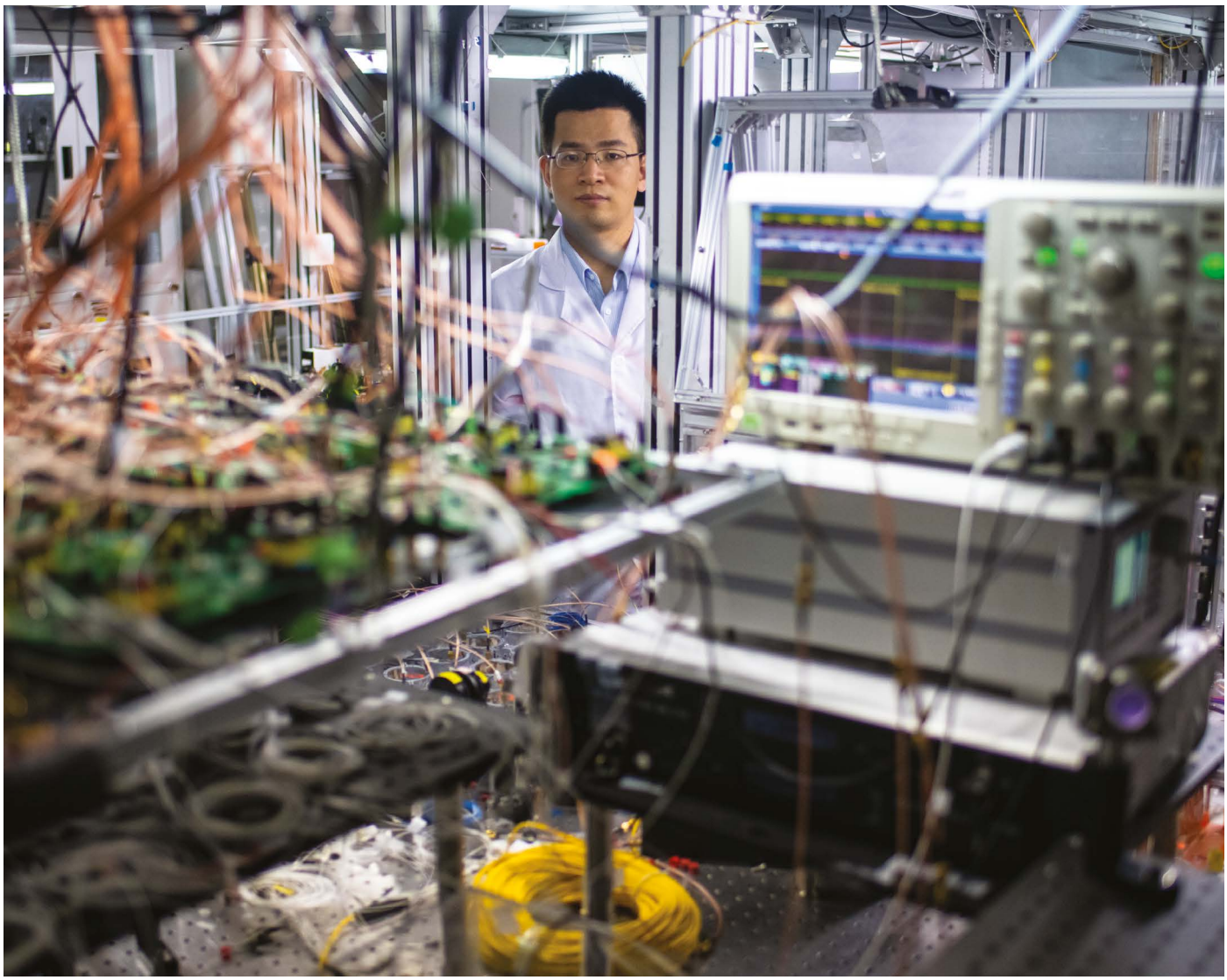

Where I work
Chao-Yang Lu

Photographed for *Nature* by Dave Tacon.

In my laboratory, we develop quantum computers based on single photons, the fundamental particles of light. In 2020, our computer was the first worldwide to demonstrate 'quantum advantage': it completed a calculation in 200 seconds that would take a conventional supercomputer more than 2 billion years.

Today's computers and mobile phones perform calculations using a binary code of 1s and 0s. Their silicon transistors can be only ever in either the 1 or the 0 state: on or off. But if we use fundamental particles such as photons to perform calculations, quantum effects come into play. In the quantum world, where a wave-like photon can be in two places at once, you can have 1 and 0 simultaneously. Quantum computers can take advantage of this 'superposition' to solve certain problems exponentially faster than classical computation can.

Here, I am looking through the control electronics part of our quantum computer. The control electronics 'phase lock' our photons so that they arrive in the computer together, with 15-nanometre precision. The machine performs calculations on the basis of the photons' interactions.

When I accepted a professorship at the University of Science and Technology of China, my first quantum machine could control only six single photons. By 2020, my team had a machine that could control up to 76, and demonstrate quantum advantage. We are now up to 130 photons.

Quantum advantage used to be called quantum 'supremacy'. It is very good that the new terminology has been adopted.

The problem that our computer solved to show quantum advantage is very abstract, a mathematical proof. My next steps are to scale the computer to control more photons — maybe 200 in the near term — and to reconfigure it for real-world applications, such as accelerating drug development by accurately predicting the interactions between candidate drugs and their targets.

Chao-Yang Lu is a quantum physicist at the University of Science and Technology of China in Hefei, China. **Interview by James Mitchell Crow.**