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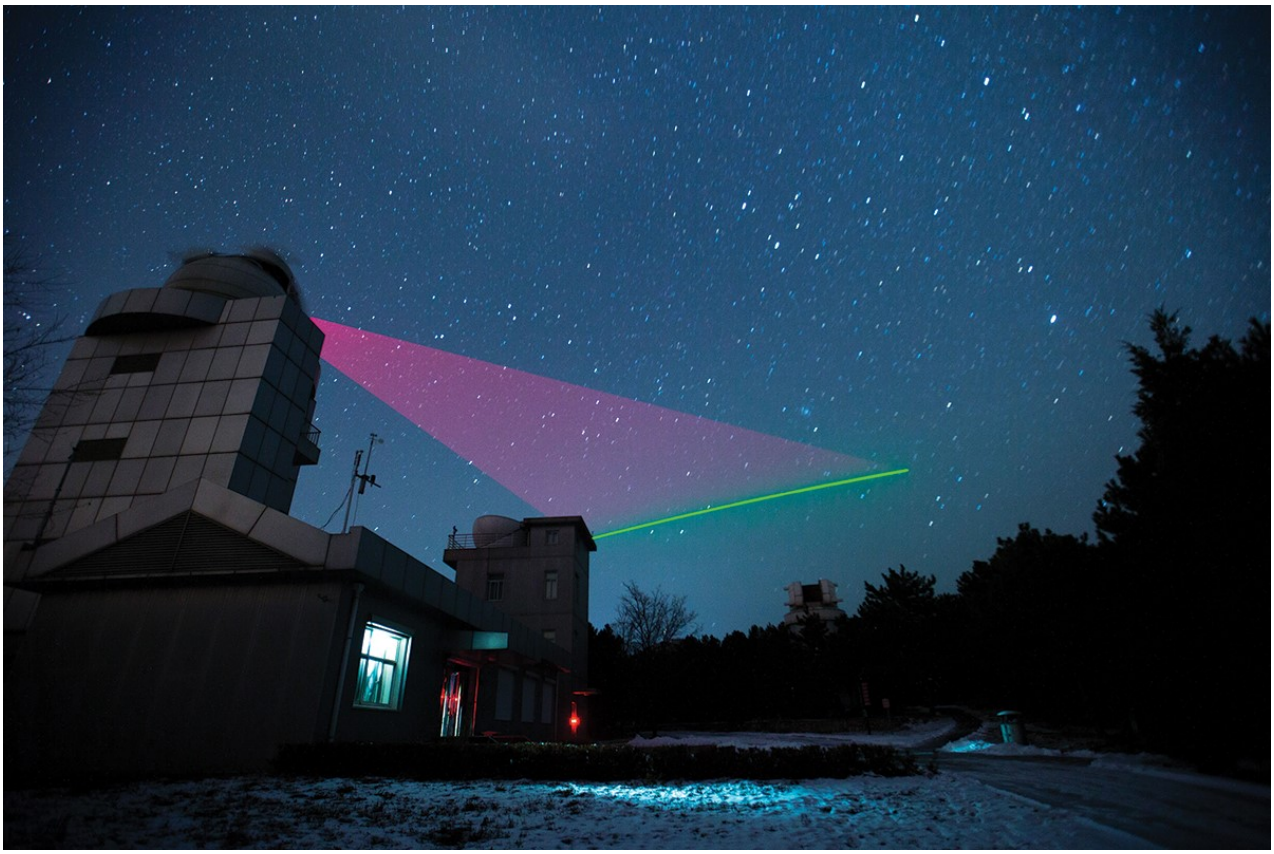
Chinese satellite beats distance record for quantum entanglement



Entangled? Then let's talk
Jin Liwang/Xinhua/eyevine

By **Anil Ananthaswamy**

LAST year, China launched the world's first quantum satellite. Now the team behind it has shown it really works, by sending entangled photons from space to stations back on Earth.

"This is the first step towards worldwide secure quantum communications, and maybe even a quantum internet," says quantum physicist Anton Zeilinger at the University of Vienna in Austria.

One of the building blocks of a secure quantum network is the ability for parties to send entangled photons. When two photons are entangled, a measurement on one instantly influences the state of the other, regardless of distance.

To create a cryptographic key, the two parties, say Alice and Bob, use the results of a series of measurements on pairs of entangled photons. The key can then be used to encrypt messages sent over a regular channel. The duo can also detect any intruder who tries to intercept and retransmit the entangled photons, because doing this destroys the entanglement.

The Chinese researchers used the Micius satellite to send entangled photons to ground stations separated by 1203 kilometres – a new record (*Science*, DOI: 10.1126/science.aan3211). "It took us almost 14 years to manage this achievement," says Jian-Wei Pan at the University of Science and Technology of China in Hefei.

First, the team had to ensure that its source of entangled photons would survive the rigours of the launch, and that the entangled photons wouldn't be destroyed while travelling through the thick and turbulent lower atmosphere.

The next challenge was for ground stations to track the fast-moving satellite and establish optical links to receive the photons. Three optical telescopes located in Delingha in Tibet, Lijiang in south-west China and Urumqi in the north-west locked on to the satellite.

For every pass of the satellite over China – occurring once every night for 275 seconds – it had to establish two downlinks simultaneously, either between Delingha and Lijiang (1203 kilometres apart) or Delingha and Urumqi (1120 kilometres apart).

Pairs of entangled photons sent through optical fibres on Earth lose signal strength with distance, meaning a 1200-kilometre fibre could only transmit one pair per second. The Chinese ground stations used adaptive optics to measure atmospheric turbulence in real time and cancel out its blurring effects, allowing the satellite to smash that barrier. "We have already improved the distribution efficiency by 12 orders of magnitude," says Pan.

Zeilinger is impressed. "It's a very important achievement," he says. "It proves that China is really able to master the technology."

This article appeared in print under the headline "China's quantum internet rises"

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