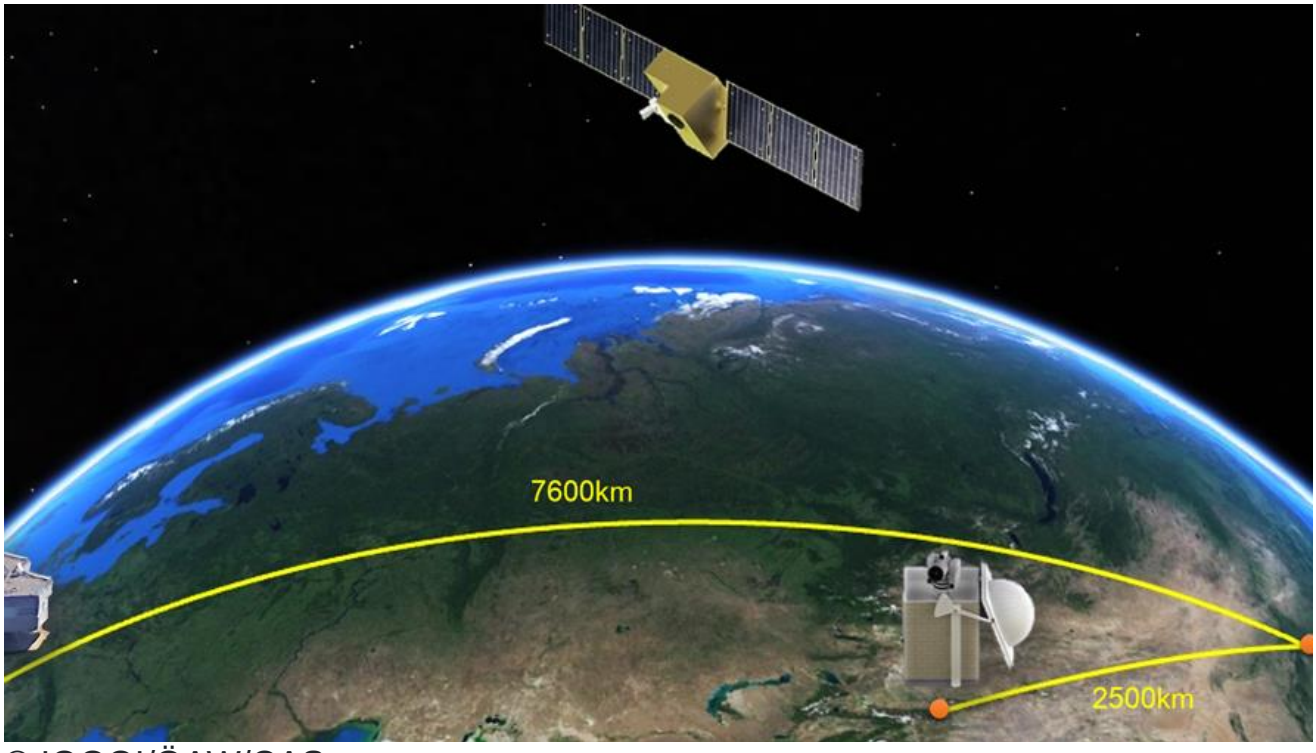
AUSTRIAN ACADEMY OF SCIENCES

SECURE QUANTUM COMMUNICATION OVER 7,600 KILOMETERS

In a newly released publication in the science journal Physical Review Letters, researchers from the Austrian Academy of Sciences, the University of Vienna and the Chinese Academy of Sciences describe how they prepared and carried out the world's first secure intercontinental "Quantum Call" in September 2017 over a record distance of 7,600 kilometers. The successful experiment clearly demonstrates the potential of quantum physics for the development of a global satellite-based quantum internet.



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The experiment attracted world-wide attention: On 29 September 2017, the first video conference encrypted via quantum methods between two continents took place. The secure "Quantum Call" between Vienna and Beijing lasted 75 minutes. With scientists and journalists in attendance, the president of the Austrian Academy of Sciences, Anton Zeilinger, together with the rector of the University of Vienna, Heinz W. Engl, conversed with Chunli Bai, the president of the Chinese Academy of Sciences. With this

successful experiment, the scientists not only entered uncharted scientific territory, they also demonstrated that a tap-proof quantum internet is no longer a utopian vision.

In the science journal Physical Review Letters, the quantum researchers of the Austrian Academy of Sciences, the University of Vienna and the Chinese Academy of Sciences now report on the quantum technologies behind the experiment. Using the Chinese research satellite "Micius" and ground stations in Austria and China, quantum keys were exchanged. Those keys were then used for the video conference, which was led via a conventional internet connection. Due to the laws of quantum physics, it was impossible for third parties to "hack" into the data exchange.

"The experiment has shown that quantum communication is absolutely secure against eavesdropping and also works on a global scale," stated quantum physicist Anton Zeilinger. His research group at the Institute for Quantum Optics and Quantum Information Vienna of the Austrian Academy of Sciences together with their collaborators at the Chinese Academy of Sciences around Zeilinger’s former doctoral student Jian Wei-Pan is not only responsible for the successful "Quantum Call". The team has been developing the building blocks for the future’s secure quantum communication for a long time.

Secure quantum connection between Austria and China

The procedure for the key exchange is not new to quantum cryptography. To date, the method used to transfer information securely against interception was to equip both sender and receiver with one such key. However, the conditions on the ground surface set limits to this method: The curvature of the earth and the signal loss in long glass fiber lines have so far prevented the application of this procedure over greater distances.

The Austrian and Chinese researchers have found their solution in orbit: With the satellite "Micius" which was launched into space in 2016, they have a science station at their disposal which orbits Earth at an altitude of approximately 500 kilometers in a time of 94 minutes. The satellite is equipped with photonic sources and detectors and thus able to generate and transmit photons. For the experiment, "Micius" sent a number of these so-called photons to ground stations which oscillated in random, unpredictable directions. Thus, the transmitter in orbit and the receiver on the surface of the earth received a randomly generated unique number sequence of zeros and ones – the quantum key. If an interception attempt had taken place during the exchange between orbit and earth, this would have been noticed by the recipient. The reason: Each measurement changes the quantum state of the particles. And so, any "hackers" are busted immediately.

That even distances of more than 7,600 kilometers between Austria and China can be bridged with such technologies was demonstrated in the quantum telephone conversation last September. For the transmission of image and sound as well as for 5 kilobytes large image files of the Austrian physicist Erwin Schrödinger and the Chinese philosopher Micius quantum keys were used for encryption and decryption, which had been created in the run-up – on the one hand between the satellite and the ground station at Lustbühel Observatory near Graz, which is used by the Space Research Institute of the Austrian Academy of Sciences, and on the other hand between "Micius" and the Chinese ground station Xinglong near Beijing.

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