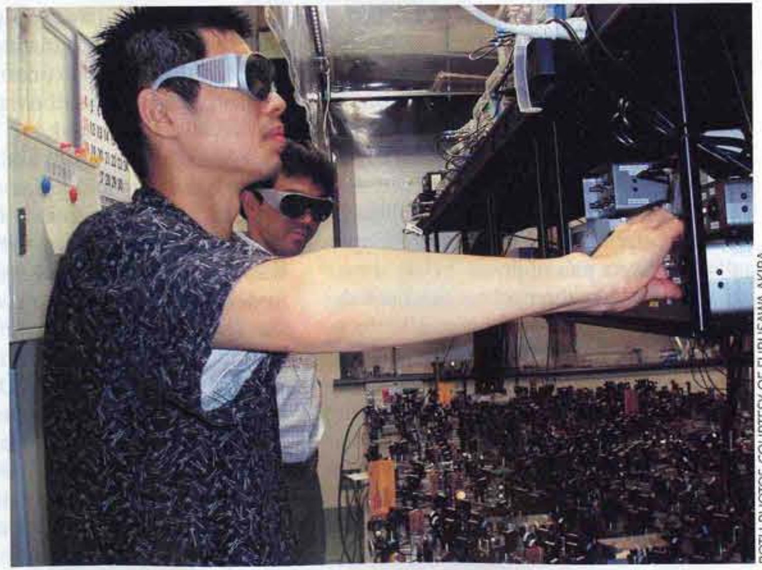
# Quantum Telecloning: Great Leaps Sideways

Quantum computers, capable of ultra-high-speed computation well beyond the realms of conventional computers, work on a principle whereby quantum systems like light quantums and atoms are entangled and controlled and used for computation. The quantum effect that is at the heart of such quantum computers is a correlation specific to quantum mechanics, called quantum entanglement. In other words, central to a quantum computer is the control of quantum entanglement between numerous quantum systems.

Professor Furusawa Akira of the University of Tokyo was the first in the world to successfully test quantum telecloning, the core technology at the heart of a quantum computer. In a quantum computer, quantum state control acts like the CPU does in a conventional computer. Quantum telecloning is a technology whereby an approximate copy of quantum states of light is made and then transferred to two distant locations. Using this telecloning technology, we will be able to consolidate the process of transferal (quantum teleportation) and approximate copying (optimal cloning) into just one step, whereas previously these needed to be carried out as separate steps.



BOTH PHOTOS COURTESY OF FURUSAWA AKIRA

One of Professor Furusawa's students works to enhance the quantum correlation between photons; right, the test device used for successful telecloning.

Furusawa has achieved two world firsts: namely his testing of deterministic quantum teleportation—the fundamental quantum entanglement control protocol—at the California Institute of Technology in 1998, and his successful transference of the state of quantum entanglement in 2004.

In the current quantum telecloning experiments, he has managed to reproduce the quantum state of light at two locations with an accuracy of around 58%, which is almost 90% of the way to the theoretical limitation for accuracy. While quantum teleportation between two parties has been previously reported around the world, there have been no successful cases to date using entanglement control between three quantum systems for telecloning. Furusawa explains, "If we are to realize quantum computers, we need to improve the performance of quantum teleportation, and to enable entanglement between multiple systems." In the future, he plans to work on boosting his track record of two consecutive quantum teleportations to four consecutive teleportations, and also plans to work on realizing entanglement between nine quantum systems. ◼

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