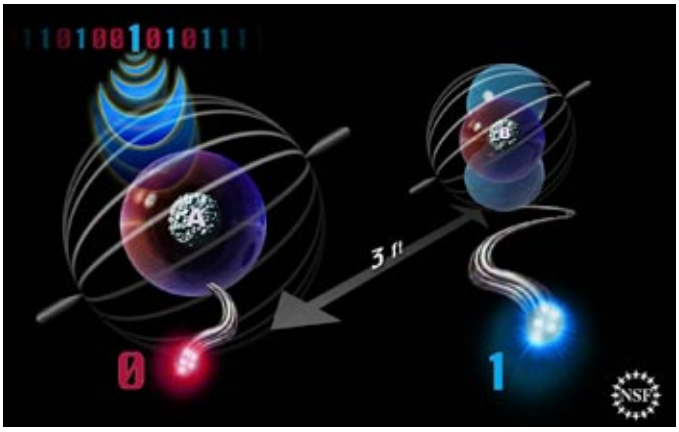
Teleporting Quantum Information from One Atom to Another

Physicists in recent years have learned how to transfer characteristics of one particle's quantum state to another particle at a separate location—a form of teleportation made possible by the strange rules of quantum mechanics. Now, researchers have for the first time succeeded in teleporting the state of an atom across a significant distance to another atom. This achievement is important because atoms can be trapped and held in the same quantum state for considerable periods of time, so they can serve as memory units for quantum information. Teleportation between atoms could therefore be an important ingredient in quantum computing or quantum communication systems.

Chris Monroe of the University of Maryland and his colleagues use brief laser pulses to put two ytterbium ions a meter apart into superposed states, in which each ion exists in two distinct states of ionization at once. This mixed state is a "qubit," the basic element of quantum computing. Then the researchers use laser pulses make the superposed ions emit a photon, which is in a superposed state like the ion it came from. A beam splitter reveals when the states of these photons are entangled, so the superposed states of the ions must also be entangled. The researchers take advantage of this quantum entanglement to conduct a microwave operation on one of the ions, which affects the state of the second, entangled ion. A microwave operation on the second ion confirms that information about the first ion's state was teleported. Monroe and his colleagues are now working to capture more photons at the beam splitter, in order to achieve teleportation more frequently.



Teleportation carries information between entangled atoms.
Image Credit: Nicolle Rager Fuller, National Science Foundation

Olmschenk, S., D. N. Matsukevich, P. Maunz, D. Hayes, L.-M. Duan, C. Monroe, "Quantum Teleportation Between Distant Matter Qubits" *Science* 2009: (323) 5913: 486–489.

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