

Entanglement study makes a quantum leap

July 9 2012, By Monte Morin

Some scientists have likened it to voodoo, while Albert Einstein called it just plain "spooky." In the bizarre realm of quantum mechanics, entanglement is the phenomenon in which two seemingly distinct particles control each other in ways that defy common physical sense. For instance, when an atom located in Beijing is measured by an observer, it will exhibit the exact opposite qualities of its entangled counterpart in Boston.

In the 1930s, the idea of [entanglement](#) seemed so absurd that Einstein derided it as "spooky action at a distance" and argued that it revealed serious shortcomings in quantum theory.

Today, however, entanglement stands as the essential feature of quantum mechanics, and scientists say its exploitation could lead to extraordinary leaps in computing, communications and cryptology. A quantum computer, they say, would take seconds to solve problems that today's PCs would take billions of years to parse. Governments, financial institutions and armies, meanwhile, are intrigued by the potential for secure long-distance communications that would instantly reveal attempts at hacking.

Those technologies may still be sometime in the future, but researchers in Germany have taken a step closer to their realization. In a report Friday in the journal *Science*, [physicists](#) at the Ludwig-Maximilians-University in Munich said they had demonstrated that two atoms separated by a distance of about 65 feet could become entangled and trigger an alert to announce that they had done so.

To visualize the phenomenon, imagine two boxes that each contain a single coin, said study co-author Wenjamin Rosenfeld. In [quantum mechanics](#), neither coin has a defined orientation - heads or tails - until an observer opens one of the boxes and sees which side is facing up. At that instant, the second coin will be found, without fail, to be lying in the exact opposite position, no matter how far away it is.

While other experiments have successfully entangled atoms, photons and diamond crystals, this was the first to do so at a long distance and include a signal, or herald, to let scientists know that entanglement had been achieved. Such a signal - in this case, a message on a computer screen - is crucial to the further study of entanglement and its future practical application, researchers said.

The experiment involved the capture of two rubidium atoms in separate "atom traps" located in different rooms. The traps used lenses and lasers to position each atom and prompt it to emit a stream of photons, or packets of light. The photons were inherently entangled with the atoms that emitted them.

Those photons sped through fiber-optic cables from the atom traps to a centralized measurement device at a rate of about 1,000 per minute. When photons from the two traps arrived simultaneously - an event that occurred roughly every 100 seconds - the atoms that sent the photons became entangled as well.

At that point, a computer heralded the achievement.

The physicists say they believe their experiment would work at distances up to about 1,000 feet. Beyond that, however, it becomes increasingly difficult to achieve the same effect due to photon loss over the length of the cable.

In an independent assessment that also appeared in Science, physicists Jurgen Volz and Arno Rauschenbeutel of the Vienna Center for Quantum Science and Technology said the study was significant.

"The experiment represents an important milestone toward the implementation of practical long-distance quantum communication protocols," they wrote.

Harald Weinfurter, the study's senior author, said he hoped the results would help address concerns raised by Einstein and others years ago. The question of whether [quantum theory](#) needed revisions might soon be answered, he said.

(c)2012 Los Angeles Times
Distributed by MCT Information Services

Citation: Entanglement study makes a quantum leap (2012, July 9) retrieved 19 April 2024 from <https://phys.org/news/2012-07-entanglement-quantum.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--