“SUPERPOSITION”

http://query.nytimes.com/gst/fullpage.html?res=9907E3D71139F93BA15756C0A960958260&sec=health&spon=&pagewanted=all (Times)

http://findarticles.com/p/articles/mi_m1571/is_n26_v12/ai_18469259

Physicists prove that matter can be in two places at once - research at the National Institute of Standards and Technology: includes a related article on overcoming the Uncertainty Principle

Insight on the News, July 15, 1996 by Phil Berardelli

Quantum mechanics has held that matter can be both particle and wave, but researchers at the National Institute of Standards and Technology have 'smeared' one atom in two places at the same time.

The researchers isolated a beryllium ion (an atom given an electrical charge by removing one of its two normal electrons) in an electromagnetic trap and pinpointed its position using a technique called laser cooling. Then, using two laser beams, each precisely tuned to a different frequency, they gently "smeared" the atom into a split condition called a superposition.

By measuring interference patterns in the laser beams, the scientists established that the atom occupied two locations. They determined it was separated by about 80 nanometers, or 800 times its original diameter. At human scale, it would be as if a person suddenly split into twins and appeared simultaneously a quarter mile apart.

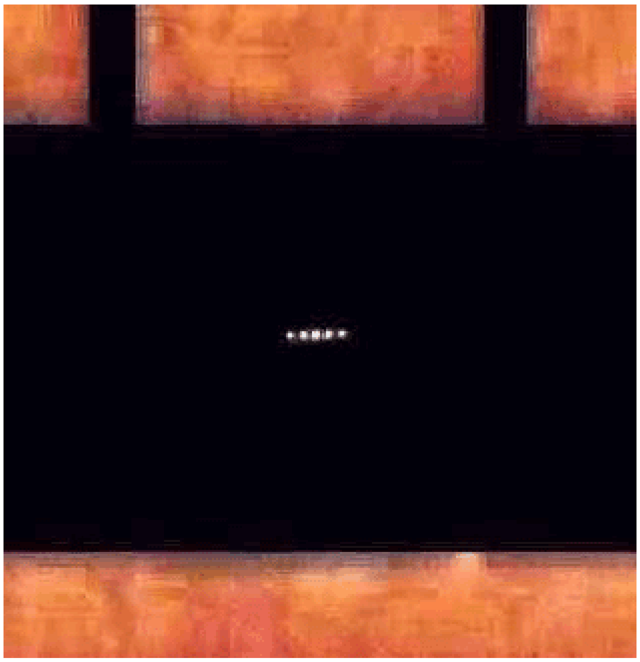
To achieve this, the beryllium atom was cooled to close to absolute zero and isolated from all types of radiation and energy sources.

The team then used lasers to force the atom's single electron into two states of spin, which also forced the atom to be in two places at the same time.

The researchers then caused the situation to break down by deliberately introducing contact to the outside world via an electrical field. Then, in some cases, they were able to reverse the process. The experiments helped the scientists determine what causes a quantum state to collapse.

Such control is necessary if scientists are to come up with practical devices that employ quantum principles.

For example, a quantum computer could store process information in the quantum states of atoms or molecules simultaneously. This would dramatically improve the power of computers. But for such a development to come about, scientists would have to be able to block the outside forces that can cause a quantum state to collapse.



Nonlinear optics has been extended into the domain of single atoms and photons, leading to a demonstration of a quantum phase gate in which one photon induces a conditional phase shift on another via their mutual interactions with an atom in an optical cavity. Single trapped atoms have been cooled to the zero point of motion, and a quantum gate has been implemented by conditionally exciting a single phonon in an ion trap.