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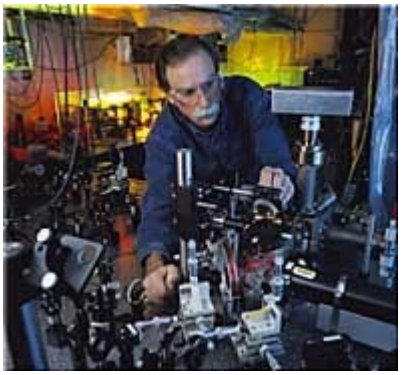
Wineland is one of Scientific American's "Top 50"

Nancy McGuire

David J. Wineland of the National Institute of Standards and Technology has been named as one of the *Scientific American* 50 for 2006. The December 2006 issue of *Scientific American* magazine lists the 50 American technology and policy leaders who have been selected for this year's recognition.



NIST physicist David Wineland adjusts an ultraviolet laser beam used to manipulate ions in a high-vacuum "ion trap" used to ´teleport´ the quantum state of one atom to another. Photo courtesy of NIST.

Wineland, who works in the Boulder, Colorado branch of the National Institute of Standards and Technology, conducts basic research to advance the science of atomic clocks and quantum-limited metrology. His work was funded in part by the Office of Naval Research. Rather than relying on springs and gears to mark the time of day, atomic clocks use the resonant frequencies of specific types of atoms to mark very brief, precise time intervals. This information is vital to the navigation and positioning systems that the Navy uses for such applications as guiding munitions and coordinating large convoys of vessels and aircraft. Also, small variations in the ambient magnetic and gravitational fields can be detected using highly precise measurements of the small changes that these fields make in an atomic clock's characteristic frequency.

Wineland was recognized this year for the progress that he and his research group have made in miniaturizing traps for holding individual atomic ions, a key factor in making the still-hypothetical quantum computer a reality. Wineland's group has provided some of the most advanced experimental demonstrations to date of quantum logic operations, the essential basic elements of the quantum computer.

Last year, the group also demonstrated the operation of an atomic clock enabled by quantum logic, a significant advance in devices whose operation depends upon quantum information technology. Wineland's group is looking into ways in which quantum logic could produce a more precise atomic clock, which could improve the performance of a quantum computer.

Wineland and his group are also exploring the use of quantum entanglement properties to produce significant precision enhancements in atomic clocks based on small groups of atoms. Quantum entanglement is observed when specific properties of two or more atoms remain related to each other, even when the atoms are separated spatially. Atomic clocks might be improved even further when this technology is adapted for use with larger groups of atoms.

Wineland said, "A general purpose quantum computer is still a distant goal, but we're pleased to see that some of the basic ingredients of quantum computation are

already finding applications—in this case for improved atomic clocks."