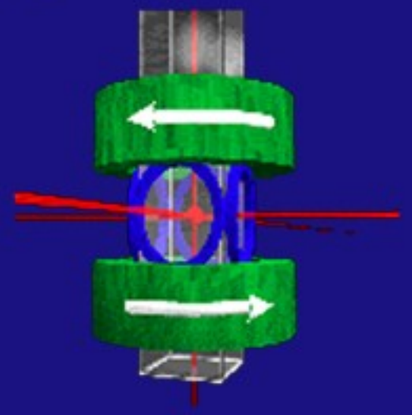
NIST and the Nobel
Celebrating 100th Anniversary of Modern Physics

Bose-Einstein
In 1925 Albert Einstein, based on theories and calculations of Indian scientist Satyendra Nath Bose, predicted that atoms cooled to extremely low temperatures would condense together and exhibit highly unusual properties. This prediction came to be known as the Bose-Einstein Condensate.

1925

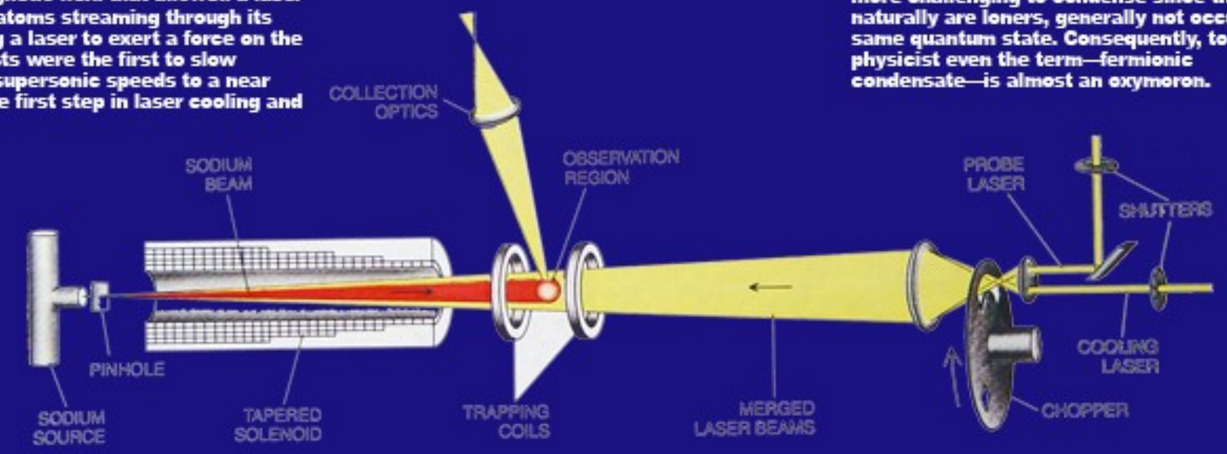


Magnetic Atom Trap
An illustration of a magnetic trap; the trap generates a magnetic field whose strength is smallest at the center, between the two donut-shaped copper rings. The atoms, which are like tiny magnets, are attracted to the weakest part of the field and held in that trap by the magnetic force.

1985

Cooling and Trapping of Atoms
In 1985, atoms were decelerated, laser cooled, and held in a magnetic trap. The Nobel was awarded to NIST's Dr. William Phillips in 1997.

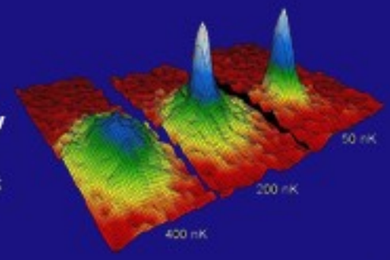
Solenoid Decelerator
An illustration of a solenoid: this cylindrical coil of wire produced a magnetic field that allowed a laser beam to decelerate atoms streaming through its hollow center. Using a laser to exert a force on the atoms, NIST scientists were the first to slow atomic beams from supersonic speeds to a near standstill – taking the first step in laser cooling and trapping.



Bose-Einstein Condensate
In 1995, the Bose-Einstein Condensate, a completely new state of matter, was created using NIST's laser cooling technique developed in 1985 and magnetic trapping/evaporative cooling technique developed at MIT. The Nobel Prize was awarded to NIST's Dr. Eric Cornell in 2001 for this work.

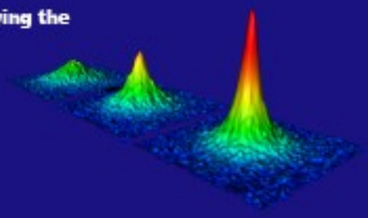
The condensate occurred when atoms were cooled to 100 billionths above absolute zero and became a cooperative entity behaving as a "superatom." The result was the experimental realization of a theory that has intrigued scientists ever since it was hypothesized by Einstein and Bose 70 years earlier.

1995



2003

Molecular Condensate
In 2003, NIST made the first observation of a "fermionic condensate," a long-sought, novel form of matter. Unlike the first condensate, which consisted of atoms in the boson family, the molecular condensate uses fermions—the other half of the particle family tree and the basic building blocks of matter. Fermions were more challenging to condense since they naturally are loners, generally not occupying the same quantum state. Consequently, to a physicist even the term—fermionic condensate—is almost an oxymoron.



Physicists hope that further research with condensates eventually will help unlock the mysteries of high-temperature superconductivity, a phenomenon with the potential to improve energy efficiency dramatically across a broad range of applications.

The Future