

Michelson Memorial Lecture, 12 September 2003
Professor William D. Phillips, NIST and University of Maryland
Mahan Hall, 19:00 USNA

ABSTRACT

Title: "Time, Einstein, and the Coolest Stuff in the Universe"

What is time? Even Einstein had a hard time answering this question, but in spite of that, we can measure time more accurately than any other quantity. Atomic clocks are the most accurate timepieces ever made, and are essential for such features of modern life as synchronization of high speed communication and the operation of the Global Positioning System (GPS) that guides ships, aircraft, land vehicles, and backcountry hikers to their destinations. The limitations of atomic clocks come from the thermal motion of the atoms: hot atoms move rapidly and suffer from time shifts as predicted by Einstein's Theory of Relativity.

Contrary to intuition, we can cool things by shining laser light on them. With laser cooling, we cool gases to less than one millionth of a degree above Absolute Zero. The slowly moving atoms in such a gas allow us to make even more accurate clocks, already so good that they would gain or lose only a second in 30 million years. Laser cooling has also made possible the observation of a long-standing prediction of Einstein: Bose-Einstein condensation, hailed as one of the most important recent scientific developments.

This talk is aimed at those with no formal scientific training. It combines live demonstrations, cartoons, music videos, and down-to-earth explanations, but also discusses some of the most exciting recent developments in physics.