Theodor Hänsch

2005 NOBEL PRIZE IN PHYSICS
Max-Planck-Institut für Quantenoptik, Garching, and
Ludwig-Maximilians-Universität, Munich, Germany

A passion for precision

Fifty years ago, the inventors of the laser were motivated by curiosity. They could not foresee that lasers would become indispensible tools for technology and science. During the last decade, lasers have revolutionized precision measurements of time and frequency. Laser frequency makes it possible to accurately count the ripples of a light wave, and they have become the most precise measuring tools available to man. Their invention has been motivated by precise optical spectroscopy of the simple hydrogen atom, which is yielding accurate values of fundamental constants and permits stringent test of fundamental physics laws. Today, laser combs provide the long missing clockwork for optical atomic clocks, with applications ranging from new tests of Einstein's theory of relativity to telecommunications and satellite navigation. Laser combs are revolutionizing molecular spectroscopy by dramatically extending the resolution and recording speed of Fourier spectrometers. High harmonic generation promises to extend frequency comb techniques and precise spectroscopy into the extreme ultraviolet and soft X-ray regime. The calibration of astronomical spectrographs with laser combs will enable new searches for earth-like planets in distant solar systems, and may reveal the continuing expansion of space in the universe. By offering control of the electric field of extremely short light pulses, laser combs have become key tools for the emerging field of attosecond science.

BIO

Theodor Hänsch was born in Heidelberg (Germany). He obtained his diploma and PhD from the Ruprecht-Karls-Universität in Heidelberg in 1969. He subsequently worked as a professor at Stanford University in California (USA) from 1975. In 1986, Prof. Hänsch returned to Germany, both as director of the Max-Planck-Institut für Quantenoptik and as Professor of experimental physics and laser spectroscopy at the Ludwig-Maximilians-Universität in Munich. In 1970, he invented a new type of laser which generated light pulses with an extremely high spectral resolution. Using this device, he managed to measure the transition frequency of the Balmer line of atomic hydrogen with a much higher precision than any previous techniques. In the late 90s, he developed with his team a new refined method to measure the frequency of laser light even more accurately, using a device called the optical frequency comb generator. He then used this new technique to measure the Lyman line of atomic hydrogen to the extraordinary accuracy of one part in one hundred trillion. With this precision we can now detect changes in the fundamental physical constants of the universe. Prof. Hänsch received the Nobel Prize in Physics in 2005 for his contributions in the development of laser-based spectroscopy.