MAX PLANCK SOCIETY

Press Release

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Physics Nobel Prize 2005 goes to Theodor W. Hänsch

Director of the Max Planck Institute of Quantum Optics in Garching, Germany shares award with two US American physicists

German physicist Theodor W. Hänsch, along with US Americans Roy J. Glauber and John L. Hall, has received this year's Nobel Prize in Physics for their contributions to the development of spectroscopy. The prize money, equivalent to last year, is 10 million Swedish Kronor (1.1 million euros). Hänsch and Hall split one-half of the award "for their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique". Glauber received the other half of the prize for his contribution to the quantum theory of optical coherence.

Image 1: *Finally, another Nobel Prize for Germany. Professor Peter Gruss, President of the Max Planck Society (far right) and Professor Bernd Huber, Rector of Ludwig-Maximilians-Universität in Munich, Germany (second from right), are among the guests that congratulated freshly honoured Nobel Prize winner Professor Theodor W. Hänsch during the press conference quickly assembled in Munich.*

Image: Picture-Alliance dpa

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The Nobel Prize is being awarded to Professor Hänsch in recognition for work that he did at the end of the 1990s at the Max Planck Institute in Garching, near Munich, Germany. He developed an optical "frequency comb synthesiser", which makes it possible, for the first time, to measure with extreme precision the number of light oscillations per second. These optical frequency measurements can be millions of times more precise than previous spectroscopic determinations of the wavelength of light.

Image 2:*Theodor W. Hänsch, Director of the Max Planck Institute of Quantum Optics and Nobel Prize Winner in Physics for 2005.*

Image: Max Planck Society

The work in Garching was motivated by experiments on the very precise laser spectroscopy of the hydrogen atom. This atom has a particularly simple structure. By precisely determining its spectral line, scientists were able to draw conclusions about how valid our fundamental physical constants are - if, for example, they change slowly with time. By the end of the 1980s, the laser spectroscopy of hydrogen had reached the maximum precision allowed by interferometric measurements of optical wavelengths.

The researchers at the Max Planck Institute of Quantum Physics thus speculated about new methods, and developed the optical frequency comb synthesizer (see Image 3). Its name comes from the fact that it generates a light spectrum out of what are originally single-colour, ultrashort pulses of light. This spectrum is made of hundreds of thousands of sharp spectral lines with a constant frequency interval.

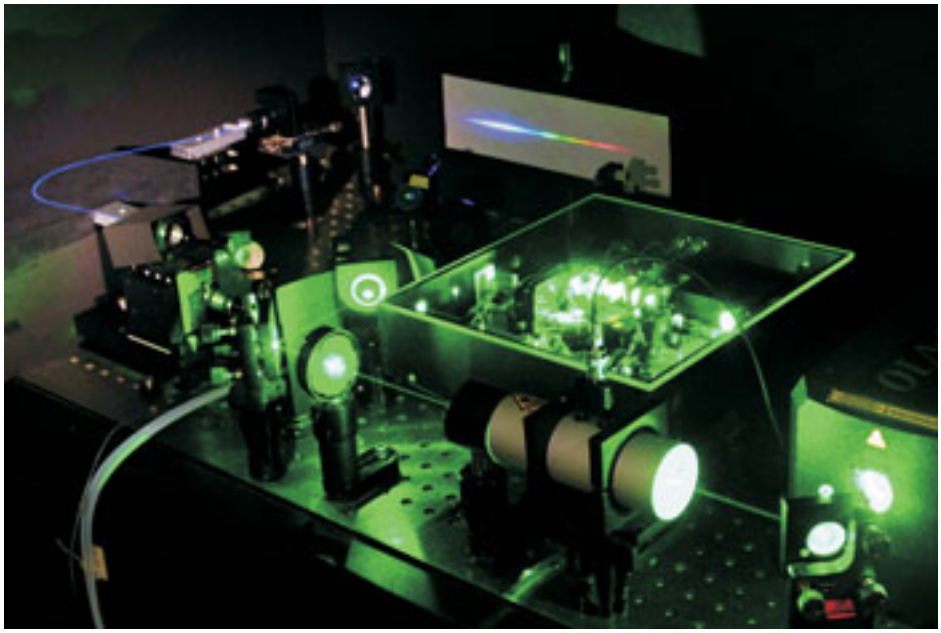

Image 3:*The fundamental components of an optical frequency comb synthesizer, which allows scientists to measure the frequency of light with extreme precision. A mode-locked femtosecond titanium-sapphire laser (middle) is pumped by the green light of a double-frequency diode-pumped solid state laser (right). A micro-structured quartz fibre diffuses the spectrum of the femtosecond laser into white light which a grating disperses into a rainbow of spectral colours.*

Image: Max Planck Institute for Quantum Optics

Such a frequency comb is similar to a ruler. When the frequency of a particular radiation is determined, it can be compared to the extremely acute comb spectral lines, until one is found that "fits". In 1998, Professor Hänsch already received a Philipp Morris Research Prize for the development of this "measurement device".

One of the first applications of this new kind of light source was to determine the frequency of the very narrow ultraviolet hydrogen 1*S*-2*S* two-photon transition. Since then, the frequency has been determined with a precision of 15 decimal places.

The frequency comb now serves as the basis for optical frequency measurements in large numbers of laboratories worldwide. Since 2002, the company Menlo Systems, in whose foundation the Max Planck Institute in Garching played a role, has been delivering commercial frequency comb synthesizers to laboratories all over the world.

Biographical details:

Theodor W. Hänsch was born in 1941 and earned his doctorate in 1969 from the University of Heidelberg. From 1972 until 1986 he was Associate Professor, and later full Professor, at Stanford University in California. He was then appointed Director of the Max Planck Institute of Quantum Optics in Garching and Professor of Experimental Physics and Laser Spectroscopy at Ludwig-Maximilians-Universität in Munich.

Among other awards, Hänsch has received the Gottfried Wilhelm Leibniz Prize of the German Research Foundation and the Philipp Morris Research Prize. He has been decorated with a Cross of Merit, First Class, of the Order of Merit of the Federal Republic of Germany, and the Bavarian Bayerischer Maximiliansorden für Wissenschaft und Kunst. This year he won the newly created Otto Hahn Prize for

Chemistry and Physics 2005.

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Related Links:

[1] The Nobel Prize in Physics 2005

[2] "Münchner Lichtzauber" - Extensive description of the optical frequency comb technique developed by Professor Hänsch (in German)

[3] "Playing to the Same Beat in the Ultra-Cold Quantum Orchestra"

[4] "The Young Kid of the Block" - Biography of Theodor W. Hänsch

[5] Laser Spectroscopy Division and Ultracold Quantum Gases of Professor Theodor W. Hänsch

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