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Letter of support for
Centre for Advanced Laser Techniques - CALT

Since the pendulum clock was invented, time and frequency have been the quantities that scientists can measure with the highest precision. Measuring a frequency, that is, counting the number of cycles during a given time interval, is intrinsically a digital procedure that is immune to many sources of noise. In 1967, the Conference Generale des Poids et Mesures (CGPM) has defined the second, our unit of time, as the period during which a cesium-133 atom oscillates 9 192 631 770 times on a hyperfine clock transition in the atomic ground state. Today, after 50 years of continuous refinement, microwave cesium atomic clocks reach a precision of 15 decimal digits.

Even much higher precision is expected from future optical atomic clocks which use atoms or ions oscillating at the frequency of light as the “pendulum.” Such clocks will greatly extend the frontiers of time and frequency metrology. They could allow the SI base unit of time, the second, to be realized with even greater accuracy in future and thus replace the current definition. The most highly precise clocks, however, cover a wide range of applications which range from geodesy, to the investigation of the "great questions" of modern physics such as a unified theory of the fundamental interactions.

All clocks must have a regular, constant or repetitive process to mark off equal increments of time. No electronic systems exist that can directly count the oscillations of microwave cesium clock or optical atomic clock. The long missing clockwork mechanism can now be realized with a femtosecond laser frequency comb, an ultraprecise measuring tool that can link and compare optical frequencies and microwave frequencies phase coherently in a single step. Optical frequency combs from mode-locked femtosecond lasers have revolutionized the art of counting the frequency of light and provide powerful tools for new tests of fundamental physics laws.

Precision measurements have always appealed to me as one of the most beautiful aspects of physics. With better measuring tools, one can look where no one has looked before. More than once, seemingly minute differences between measurement and theory have led to major advances in fundamental knowledge. With that in mind, I gladly support the researchers of the Institute of Physics in Zagreb in their initiative to establish the Centre for Advanced Laser Techniques (CALT). In particular, I strongly support their activities in raising capacities in time and frequency precision measurements, developing the optical atomic clock, the first state-of-the-art optical frequency standards in the South Eastern Europe, and laser frequency comb spectroscopy.

Garching, August 29, 2016

Theo H

Prof. Theodor W. Hänsch