

# Linking the International System of Units to Fundamental Constants

Autor: Joachim Ullrich\*

\* Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig, Germany  
Email: joachim.ullrich@ptb.de

In November 2018, the General Conference for Weights and Measures, CGPM, established by the Metre Convention in 1875, decided in its 26<sup>th</sup> meeting on the revision of the International System of Units (SI). The signatory states of the Metre Convention represent about 98 % of the world's economic power and, thus, the SI is the very foundation of global, international trade and the reliability of measurements worldwide. As outlined by Max Planck in his famous paper of 1900 postulating the "Planck constant", the revised SI shall be based on fixing the numerical values of "defining constants": the velocity of light, the elementary charge, the Boltzmann, Avogadro and the Planck constants, the Cs hyperfine clock transition and the luminous efficacy. The revision represents our present theoretical understanding of the microscopic world and is meant to ensure that the units are valid and realisable "for all times, for all people", the vision formulated during the French revolution, extended by Max Planck "for all times and civilizations, throughout the Universe".

In the talk an overview will be provided on the revised SI, its advantages as compared to the previous definitions, focusing in particular on future perspectives with improved realisation of the units exploiting innovative technologies. The question remains if the fundamental constants used as "defining constants" are indeed constant in time. Next generation clocks bear the promise of tracing potential changes in the fine structure constant  $\alpha$  at the level of  $\Delta\alpha/\alpha \approx 10^{-20}$  per year.