



Linking the International System of Units to Fundamental Constants

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In November 2018, the General Conference for Weights and Measures, CGPM, established by the Metre Convention in 1875, decided at its 26th 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 underpins global 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 Boltzmann, the Avogadro and the Planck constants, the velocity of light, the elementary charge, the Cs hyperfine clock transition and the luminous efficacy. The revision is based on our present theoretical understanding of the microscopic world and is meant to ensure that the units are valid and realizable "for all of time, 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 progress, challenges and future perspectives of the revised SI, sometimes dubbed "Quantum SI", illustrated in Fig. 1. If time allows, major current developments in the realisation and dissemination of the second will be reported. For example, next-generation optical clocks using transitions in highly-charged ions, that are read out via quantum-logic schemes, or clocks based on nuclear transitions will allow investigation of the question if the fundamental constants are indeed constant in time. These techniques bear the promise to trace potential changes in the fine structure constant α at the level of $\Delta\alpha/\alpha \approx 10^{-20}$ per year.

