

Chapter 18

On a Redefinition of the SI Second

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Abstract Optical atomic clocks like optical lattice clocks or single-ion clocks have outperformed the best cesium atomic clocks that realize the base unit of time in the International System of Units (SI) with respect to accuracy and stability. With fractional uncertainties in the 10^{-18} regime and fractional instabilities of a few 10^{-16} in 1 s, optical atomic clocks are presently the most accurate measuring devices at all.

The status of optical clocks and the different means to compare remote clocks will be reviewed. Recent experiments to address the question of the constancy of fundamental constants or their application in the novel field of relativistic geodesy will be discussed. All these developments will eventually ask for a new definition of the unit of time based on optical frequency standards, thereby replacing the cesium standard in the SI. In the second part of this talk, the question what will be the necessary prerequisites and challenges for such a redefinition will be addressed. The current status of the discussion will be reported and an attempt for a tentative roadmap toward such a redefinition of the second in the SI will be given.

Keywords Optical atomic clocks • Redefinition of the second • Relativistic geodesy • Constancy of fundamental constants

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