

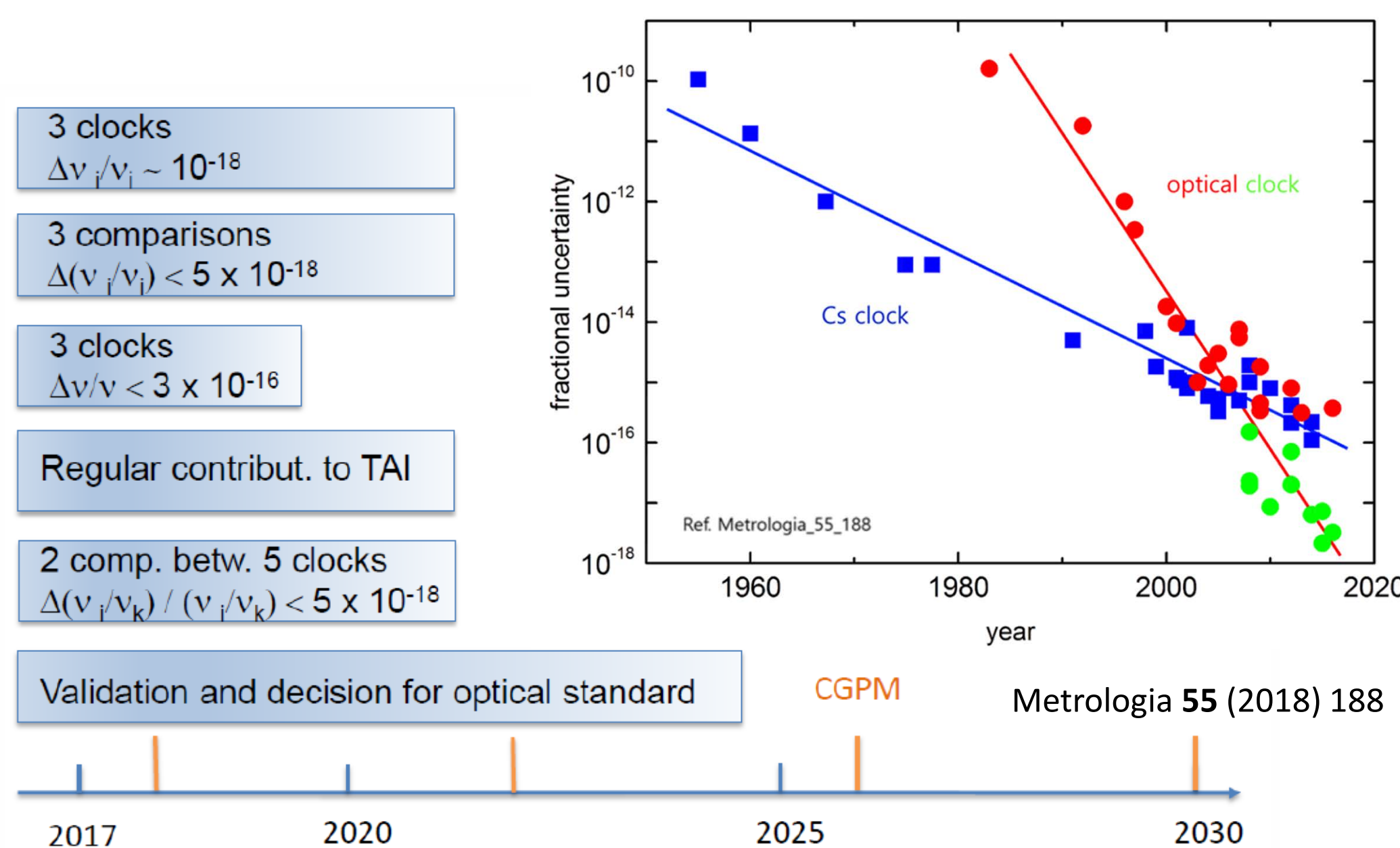
Ytterbium Optical Lattice Clocks at KRISS for the Redefinition of the Second – Their Development and Comparison

Won-Kyu Lee, Huidong Kim, Chang Yong Park, Dohyeon Kwon, SungNam Park, Myoung-Sun Heo, and Dai-Hyuk Yu
Korea Research Institute of Standards and Science (KRISS), E-mail oneqlee@kriss.re.kr

Abstract

With the development of optical clocks, the second is expected to be redefined possibly in 2030. KRISS (Korea Research Institute of Standards and Science) has developed Yb optical lattice clocks to contribute to the redefinition of the second since 2002. The absolute frequency of the first Yb optical lattice clock at KRISS (KRISS-Yb1) has been reported in 2013, 2017, and 2021, contributing to the determination of the BIPM recommended values of standard frequencies. KRISS-Yb1 has contributed to the steering of the International Atomic time (TAI) since 2021, and is now being operated regularly to contribute to TAI. It was the most frequently contributing optical clock for the last two years. The systematic uncertainty of KRISS-Yb1 was limited to 1.7×10^{-17} mainly due to the blackbody radiation (BBR) shift uncertainty. The second Yb optical lattice clock (KRISS-Yb2) was developed to reach the 10^{-18} uncertainty level overcoming this BBR shift uncertainty. Intercontinental optical clock comparisons are necessary for the redefinition of the second. For this comparison, several methods are under development at KRISS with international collaboration, including the VLBI (Very Long Baseline Interferometer), ACES (Atomic Clock Ensemble in Space), GPS PPP-AR (Precise Point Positioning with Ambiguity Resolution), and a transportable optical clock.

Redefinition of the second by optical clocks



- Optical clocks have better performance than the cesium clocks since 2005.
- 2026 CGPM : validate a roadmap toward redefinition (Metrologia 61, 012001 (2024))
- 2030 CGPM : redefinition of SI second expected
- KRISS has been developing ytterbium clocks for the redefinition of the second since 2002.

KRISS-Yb1 for the TAI contribution

