Contributions of the Optical Lattice Clock NICT-Sr1 to TAI Calibration and UTC(NICT) steering

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Our efforts with the optical lattice clock NICT-Sr1 are now focused on contribution to both the international and the local timescale. Since 2018, NICT-Sr1 has been recognized as a secondary frequency standard and frequently contributed to BIPM's monthly calibration of the rate of the international atomic time TAI. This fulfills one of the criteria that the Consultative Committee for Time and Frequency CCTF set for the redefinition of the SI second.

The same criteria also require contribution of an optical clock to the generation of a local timescale UTC(*k*), which has recently gained significant attention [1-5]. NICT-Sr1 began contributing to the generation of Japan Standard Time JST in August 2021. To this end, NICT-Sr1 intermittently evaluates the frequency and drift rate of a hydrogen maser (H-maser) to steer its frequency and generate a timescale signal TA(Sr). We demonstrated this optically steered timescale in 2016 [6] and resumed its generation in July 2021.

NICT generates and provides the local timescale UTC(NICT), from which JST is derived by adding +9 hours. UTC(NICT) is originally generated by adjusting a H-maser source frequency to the calculated local ensemble time derived from 18 commercial cesium atomic clocks. Since August 2021, we add an additional twice weekly steering of the conventionally generated UTC(NICT) to compensate the timing drift between UTC(NICT) and TA(Sr). The peak-to-peak variation of the deviation of UTC(NICT) from UTC has subsequently improved from approximately 40 ns to 11 ns as shown in Fig. 1.

We believe that these contributions to the international and the nationally distributed timescale help demonstrate the suitability of optical clocks as the basis for a redefined SI second.

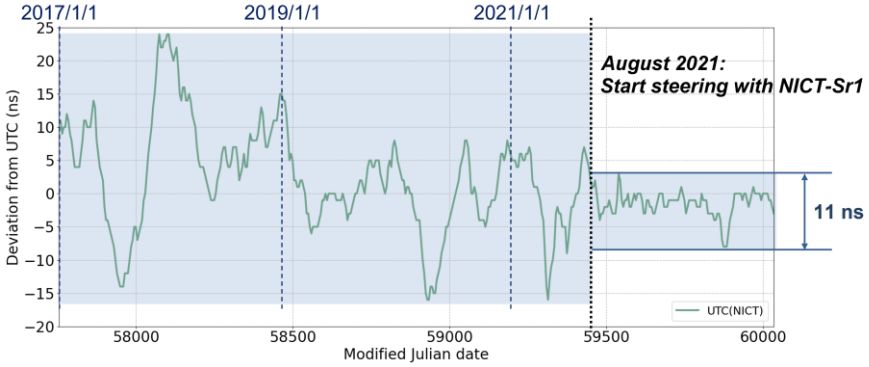

Fig.1. Deviation of UTC(NICT) from UTC since 2017, where steering of UTC(NICT) towards TA(Sr) started since August 2021.

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