

Operation of the METAS-FOC2 primary frequency standard in 2019

The Swiss continuous Cs fountain clock METAS-FOC2 [1] delivered one contribution to the calibration of TAI, which was published in Circular T 377 in May 2019. During this observation period, the standard was operated without dead time. The local oscillator was the METAS hydrogen maser (HM, BIPM clock code 1405701). The typical short-term frequency instability of METAS-FOC2 was $4 \times 10^{-13} (\tau/s)^{-1/2}$. The following table summarizes the published values:

#	Evaluation period	$d / 10^{-15}$	$u_A / 10^{-15}$	$u_B / 10^{-15}$	$u_{\text{lab}} / 10^{-15}$	$u_{\text{TAI}} / 10^{-15}$	$u_{\text{total}} / 10^{-15}$
1	57809-57839	-1.07	1.00	1.38	0.04	0.27	1.73

Important maintenance works were carried out during this year, with the replacement of the main ion pump and of the light-trap [2], and with a Cs refill. These modifications took a few months and were the opportunity to update some other minor hardware parts.

Four other 30-days long measurement series were accumulated in July, September, November and December 2019 for control purposes.

The following table shows the uncertainty budget ($k=1$) used for the calibration in May 2019:

Physical effect	Frequency shift / 10^{-15}	Uncertainty / 10^{-15}
Second-order Zeeman	23.53	0.20
Gravitational	59.72	0.02
Second-order Doppler	-0.01	<0.01
Blackbody radiation	-16.67	0.04
Microwave spectrum purity	0.00	0.05
Light shift from source	-0.16	0.04
Cavity pulling	0.00	<0.01
Rabi pulling	0.00	0.02
Ramsey pulling	0.05	0.10
End-to-end	2.17	0.27
Collisional Cs-Cs	-0.33	1.26
Light shift from detection	-0.10	0.41
RF leakage	0.00	0.47
Majorana transitions	0.00	0.50
DCPS	—	1.03
Total	66.19	1.38

Reference

- [1] A. Jallageas et al., *Metrologia* **55** 366, (2018).
 [2] F. Füzesi et al., *Rev. Sci. Instrum.* **78** 103–109, (2007).