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Dear Dr. Arias, BIPM,

Attached is the report on the frequency measurement by NMIJ-F1, a cesium atomic fountain frequency standard of NMIJ, during **MJD 55529-55559.** The uncertainty evaluation was the same as that in the last publication.

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# Frequency comparison between H-Maser(405003) and Cs Fountain(NMIJ-F1) during MJD 55529-55559

The frequency of our Hydrogen maser HM(Clock # 405003) have been measured using NMIJ-F1 during MJD 55529-55559 (30 days). The results are shown in tables 1.

Table 1. Results of the comparison in $1\text{x}10^{-15}$ unit.

| **Period** | **55529-55559** |
|---|---|
| Measurement ratio | 93.7% |
| Y(NMIJ-F1)-Y(Maser 405003) | -11.1 |
| $u_A$ | 0.7 |
| $u_B$ | 3.9 |
| $u_{link/lab}$ | 0.3 |

1. Type A uncertainty $u_A$

The frequency stability $\sigma_y(\tau)$ is $1\times10^{-12}\,\tau^{-1/2}$. This equation has been used for the estimation of type A uncertainty on the basis of white FM noise. The measurement uncertainty is $0.7\times10^{-15}$.

2. Uncertainty of the link in the laboratory $u_{link/lab}$

The uncertainty of the link in the laboratory, $u_{link/lab}$, is written as,

$$u_{link/lab} = \sqrt{u_{dead\ time}{}^2 + u_{link/maser}{}^2} \qquad (1)$$

where $u_{link/maser}$ is the uncertainty due to the phase noise of the synthesis chain between the fountain and HM, $u_{dead\ time}$ is the uncertainty due to the operational dead time of the fountain. ($u_{link/maser}$, $u_{dead\ time}$) are evaluated to be $(2\times10^{-16}, 2\times10^{-16})$.

3. Type B uncertainty $u_B$

The value of type B uncertainty is the same as the last publication, as is shown in table 2.

Table 2: Frequency biases and uncertainties in NMIJ-F1 during the period MJD 55529-55559 in $1\times10^{-15}$ unit.

| Source of uncertainty | Bias | Uncertainty |
|---|---|---|
| $2^{nd}$ order Zeeman | 292.7 | 0.5 |
| Blackbody radiation | -18.0 | 1.4 |
| Gravitation | 1.6 | 0.1 |
| Cold collisions | 0.0 | 3.3 |
| Distributed cavity phase | 0.0 | 1.2 |
| Microwave power dependence | 0.0 | 0.7 |
| Total | 276.3 | 3.9 |