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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 54859-54889**. The uncertainty evaluation was the same as that in the last publication.

Shinya Yanagimachi  
Akifumi Takamizawa  
Takeshi Ikegami

National Metrology Institute of Japan (NMIJ)  
Time and Frequency Division  
Time Standards Section  
AIST Tsukuba Central 3, Tsukuba-Shi, Ibaraki-Ken 305-8563, Japan

## Frequency comparison between H-Maser(405002) and Cs Fountain(NMIJ-F1) during MJD 54859-54889

The frequency of our Hydrogen maser HM(Clock # 405002) have been measured using NMIJ-F1 during MJD 54859-54889 (30 days). The results are shown in tables 1.

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

| Period                     | 54859-54889 |
|----------------------------|-------------|
| Measurement ratio          | 98.2%       |
| Y(NMIJ-F1)-Y(Maser 405002) | -202.8      |
| $u_A$                      | 0.7         |
| $u_B$                      | 3.9         |
| $u_{link / lab}$           | 0.3         |

### 1. Type A uncertainty $u_A$

The frequency stability  $\sigma_y(\tau)$  is  $1 \times 10^{-12} \tau^{-1/2}$ . This equation has been used for the estimation of type A uncertainty on the basis of white FM noise. The measurement uncertainty is  $0.7 \times 10^{-15}$ .

### 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,

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

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  $(2 \times 10^{-16}, 2 \times 10^{-16})$  for the period of MJD 54859-54889.

### 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 54859-54889 in  $1 \times 10^{-15}$  unit.

| Source of uncertainty        | Bias  | Uncertainty |
|------------------------------|-------|-------------|
| 2 <sup>nd</sup> order Zeeman | 174.9 | 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                        | 158.5 | 3.9         |