VLBI MEASUREMENTS FOR FREQUENCY TRANSFER

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The atomic fountains have already archived the uncertainty of 10^{-15} at a few days. Moreover optical clocks have the potential to realize the uncertainty on a 10^{-16} to 10^{-17} level after a few hours. On the other hand, frequency transfer precision of the two-way satellite time and frequency transfer and GPS carrier phase experiments have reached the 10^{-15} at 1day level. In order to compare such primary frequency standards by these time transfer techniques, it is necessary to average over long periods. Since these techniques are not sufficient to compare next standards improvements of high precision time transfer techniques are strongly desired. VLBI that is one of the space geodetic techniques measures the arrival time delays between multiple stations utilizing radio signals from distant celestial radio sources. In the usual geodetic VLBI analysis, clock offsets and their rates of change at each station are estimated with respect to a selected reference station. The averaged formal error (1 sigma) of the clock offsets is typically about 20 picoseconds when analyzing geodetic VLBI experiments which are regularly conducted by the International VLBI Service for Geodesy and Astrometry (IVS). This precision is nearly one order better than other techniques like GPS carrier phase or TWSTFT.

In this study, to confirm the potential of the current VLBI frequency transfer, we have compared the results of the VLBI and GPS carrier phase frequency transfer using data from the IVS and the International GNSS Service (IGS). We selected the two stations (Onsala, Wettzell) which belong to IVS and IGS network. These two stations have in common that at each site VLBI and GPS are sharing the hydrogen maser.

The results of the VLBI frequency transfer show that the stability follows a 1/tau law very closely (phase noise dominant). And that shows the stability have reached about 2×10^{-11} (20ps) at 1 sec. In this study, the results show that VLBI frequency transfer is more stable than GPS on the same baseline and same period. Based on these findings, we will discuss about the possible improvements of frequency transfer using the compact VLBI system. Additionally, the results of the comparison experiments using Kashima-Koganei baseline by the same purpose will be presented.

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