Kashima and Koganei 11-m VLBI Stations

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Abstract

Two 11-m VLBI antennas at Kashima and Koganei are continuously operated and maintained by the National Institute of Information and Communications Technology (NICT). This brief report summarizes the status of these antennas, the staff, and the activities during 2010.

1. Introduction

Figure 1. 11-m VLBI antennas at Kashima (left) and Koganei (right).

Two 11-m VLBI antennas at Kashima and Koganei (Figure 1) used to be stations of the Key Stone Project (KSP) VLBI Network. The network consisted of four VLBI stations at Kashima, Koganei, Miura, and Tateyama (Figure 2). These 11-m antennas and other VLBI facilities at Miura and Tateyama stations have been transported to Tomakomai Experimental Forest of the Hokkaido University and to the campus of Gifu University, respectively. As a consequence, two 11-m stations at Kashima and Koganei are remaining as IVS Network Stations. The KSP was a research and development project of the National Institute of Information and Communications Technology (NICT, formerly Communications Research Laboratory) [1]. After the regular VLBI sessions with the KSP VLBI Network terminated in 2001, the 11-m VLBI stations at Kashima and Koganei have mainly been used for the purposes of technical developments and miscellaneous observations.

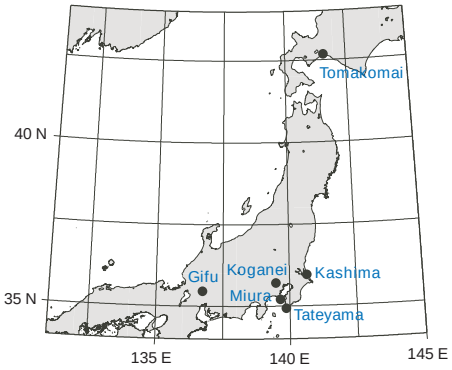

Figure 2. Geographic locations of four KSP VLBI stations and two stations at Tomakomai and Gifu.

2. Current Status

The main specifications of the antennas are summarized in Table 1. Both antennas can observe S and X-band. Originally, the specifications of these antennas were the same. However, the specifications were changed due to improvement and breakdown of equipment.

Table 1. The specifications of the KSP 11-m antennas.

		Kashima	Koganei
Antenna Type		Cassegrain type	
Diameter of the Main Reflector		11 m	
Mount Style		Az El mount	
Latitude		N 35° 57' 20.13"	N 35° 42' 38.01"
Longitude		E 140° 39' 26.90"	E 139° 29' 17.10"
Height of Az/El intersection above sea level		62.4 m	125.4 m
Input Frequency (MHz)	S band	2212 ∼ 2360	2212 ∼ 2360
	X Low band	7700 ∼ 8200	7700 ∼ 8200
	X High band	8180 ∼ 8680	8180 ∼ 8600
Local Frequency (MHz)	S band	3000	3000
	X Low band	7200	7200
	X High band	7680	7600

In 2009, we installed the radio frequency (RF) distribution system using optical fibers at Koganei to transmit the reference signal to the VLBI back end which is coherent with Universal Time, Coordinated (NICT). Therefore, the reference signal (10MHz/1PPS) at Koganei station is coherent with UTC(NICT) [2]. In November 2009, we observed the all-sky Tsys of Kashima and Koganei antennas to research the influence of radio frequency interference (RFI) signal. In X-band, we did not see the RFI signal. However, in S-band, we detected interference from the RFI signal at each station. At Kashima, we introduced a more narrow band-pass filter to reject the RFI signal in early 2010. In April 2010, we introduced another band-pass filter (2212 ∼ 2360

MHz) at both stations. Figure 3 shows the intermediate frequency (IF) spectrum at S-band (left: Kashima 11m, right: Koganei 11m). In the last annual report, we described that we changed the phase calibration (P-cal) unit from 5-MHz to 1-MHz signal. However, we changed back the P-cal unit to 5-MHz signal at both stations, because the 1-MHz P-cal unit was found out to be unstable. Additionally, we set up a precise temperature control room at the Kashima 11m observation room.

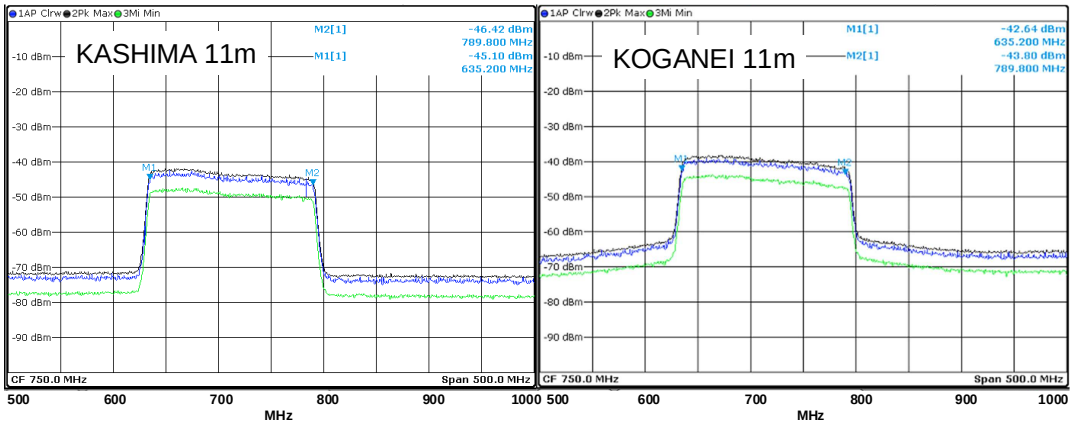

Figure 3. The IF spectrum in S-band (left: Kashima 11m, right: Koganei 11m).

3. Activities in 2010

Since 2007, we have been performing special purpose geodetic VLBI experiments between the Kashima (11-m or 34-m) and Koganei (11-m) stations to evaluate the capability of geodetic VLBI for precise time and frequency transfer. In 2010 we carried out two inter-comparison experiments (August and October) on the Kashima 11m - Koganei 11m baseline. Thereby we compared results from VLBI, GPS, TWSTFT with a DPN code and time comparison equipment (TCE) on the satellite ETS-8. For both experiments, we used two types of sampling systems named K5/VSSP32 and K5/VSI (ADS1000 and ADS3000+). About the results of these experiments, please see the NICT "Analysis Center" and "Technology Development Center" reports in this volume.

In order to verify our technical developments, experiments on Kashima-Koganei baselines have also been conducted for several purposes. These experiments include e-VLBI observations, geodetic observations using MARBLE (Multiple Antenna Radio-interferometry of Baseline Length Evaluation) system, and many others. In particular, we carried out dedicated experiments such as "RF direct sampling", "crystal clock tests for T&F", and "feeding multiple samplers (K5/VSSP32) to one PC".

Apart from the VLBI sessions, the Space Environment Group of NICT started to use the 11-m antenna at Koganei to download data from the STEREO spacecraft. Two STEREO spacecraft were launched by NASA in October 2006 to investigate the solar terrestrial environment and to provide 3D images of the Sun and solar storms. The Koganei 11-m antenna is therefore operated for this purpose when no VLBI sessions are scheduled.

4. Staff Members

The 11-m antenna stations at Kashima and Koganei are operated and maintained by the Space-Time Standards Group at Kashima Space Research Center, NICT. The staff members of the group are listed in Table 2. The operation and maintenance of the 11-m VLBI station at Koganei is also greatly supported by Space-Time Standards Group, Space Environment Group, and Space Communications Group at Koganei Headquarters of NICT. We are especially thankful to Jun Amagai and Tadahiro Gotoh for their support.

Table 2. Staff members of Space-Time Standards Group, KSRC, NICT.

Name	Main Responsibilities
KAWAI Eiji	Antenna Systems
ICHIKAWA Ryuichi	Meteorological Sensors, IGS Receivers
AMAGAI Jun	Antenna System and Timing Systems at Koganei 11m station
SEKIDO Mamoru	Field System, Calibration and Frequency Standard Systems
HASEGAWA Shingo	System Engineer

5. Future Plans

In 2011, we plan to continue precise time transfer VLBI experiments and e-VLBI developments. In addition to the VLBI observations and developments, the data downlink from the two STEREO spacecraft will be continued. Additionally, we are planning to set up the following things to improve the antenna's condition for precise time and frequency transfer VLBI experiments:

- overhaul the Hydrogen maser
- adjust the phase calibration (P-cal) unit
- develop the digital phase calibration unit

References

[1] Special issue for the Key Stone Project, J. Commun. Res. Lab., Vol. 46, No. 1, March 1999.

[2] Fujieda, M., M. Kumagai, S. Nagano, and T. Gotoh UTC(NICT) signal transfer system using optical fibers, IVS NICT-TDC News, No. 31, 17-20, 2010.