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 report summarizes the status of these antennas, the staff, and the activities in 2012.

1. General Information

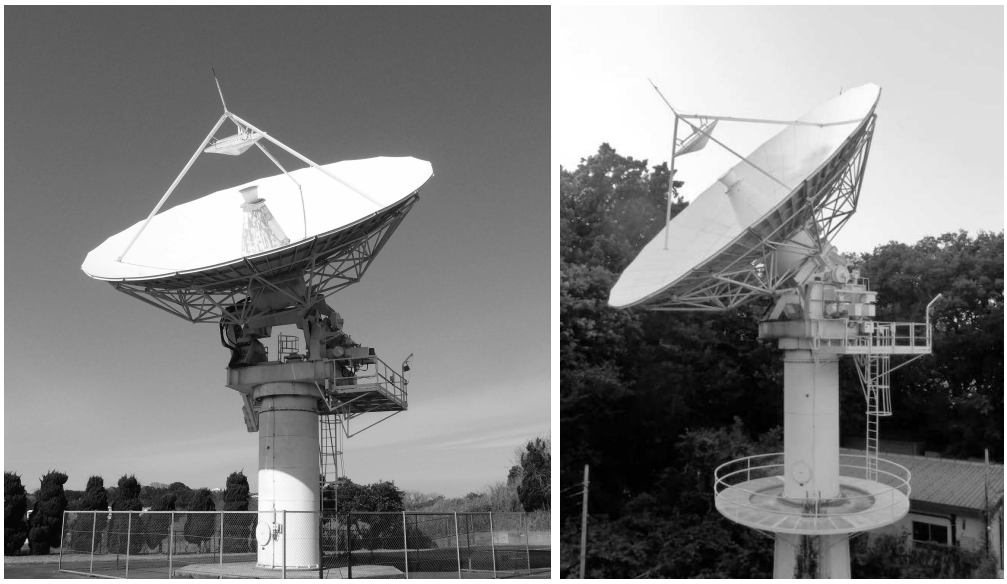

Figure 1. 11-m VLBI antennas at Kashima (left) and Koganei (right).

Two 11-m VLBI antennas at Kashima and Koganei (Figure 1) have been operating for the monitoring of crustal deformation of the Tokyo metropolitan area (Key Stone Project) since 1995 [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 research and technical developments.

2. Component Description

The antenna parameters of Kashima-11 and Koganei-11 are summarized in Table 1. The band-pass filters for S-band (2215-2375 MHz) have been installed since 2010 for RFI mitigation at both stations. A phase calibration signal (P-cal) of 5 MHz interval has been used instead of a 1 MHz interval at these KSP stations.

Table 1. The antenna parameters of the 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' 19.46"	N 35° 42' 37.89"
Longitude		E 140° 39' 26.86"	E 139° 29' 17.06"
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	8100 ∼ 8600
Local Frequency [MHz]	S band	3000	3000
	X Low band	7200	7200
	X High band	7680	7600
SEFD [Jy]	X-band	5700	9500
	S-band	3300	5500

2.1. Kashima-11

The original design of these antennas was identical. However, the frequency of the first local oscillator of X-H band at the Kashima 11-m station was changed by 80 MHz in 2008, so that the observation frequency range became the same as that of the Kashima 34-m station. A compact hydrogen maser atomic time standard was installed in November 2011. Since then the reference signal of the Kashima 11-m station has been provided from this frequency standard. Also, a precise temperature control box (PTCB: Figure 2) has been used since 2010 to keep the environmental temperature of the reference signal distribution unit, which is sensitive to temperature variation, constant. The PTCB can keep the air temperature variation in the box within a few tenths of degrees, while the room temperature around the PTCB varies in the range of a few degrees under the control of a standard air conditioner.

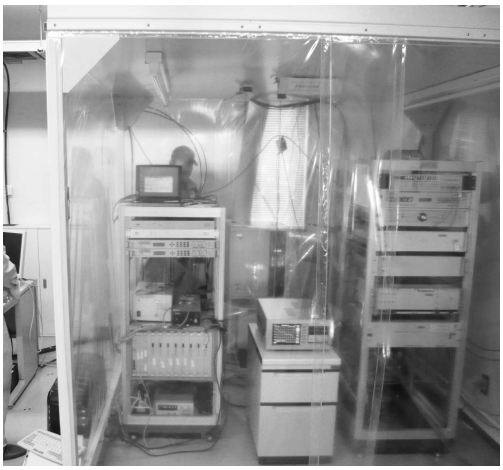

Figure 2. Precise temperature control box located at Kashima 11-m Station.

2.2. Koganei-11

The reference signal (5 MHz) has been provided from an H-maser standard, which has been synchronized to the UTC(NICT), through the optical loop-back controlled reference signal trans-

mission system since 2009 [2]. Therefore the clock of the Koganei 11-m station is highly stable, and its rate is maintained to be close to zero with respect to the UTC.

3. Staff

The 11-m antenna stations at Kashima and Koganei are operated and maintained by the members of the Space-Time Standards Laboratory. The staff members contributing to the operation and maintenance of the 11-m antennas are as follows:

- AMAGAI Jun (Okinawa): has supported Antenna System and Timing Systems at the Koganei 11-m station. He moved to Okinawa Electromagnetic Technology Center in July 2012.
- HASEGAWA Shingo (Kashima): Maintenance of computer system.
- ICHIKAWA Ryuichi (Koganei, Tokyo): Maintenance of meteorological sensors and IGS receivers.
- KAWAI Eiji (Kashima): Overall antenna system.
- SEKIDO Mamoru (Kashima): Operation and overall maintenance of the VLBI systems.
- TAKEFUJI Kazuhiro (Kashima): Operation and maintenance of data acquisition system.

The operation and maintenance of the 11-m VLBI station at Koganei have been also supported by the Space Weather and Environment Informatics Laboratory and the Space Communication Systems Laboratory at the Koganei Headquarters of NICT.

4. Current Status and Activities

The two 11-m antennas have been used for a variety of VLBI sessions and single dish sessions as follows:

International and Domestic VLBI Observation for Geodesy: The Kashima region was widely affected by the big earthquake that occurred on March 11, 2011 in the north east area of Japan. Fortunately the Kashima 11-m and Koganei 11-m stations were not seriously damaged. These two antennas have been participating in IVS-T2, APSG, and JADE sessions since 2011. These participations are important for monitoring the change of the global positions of the Kashima and Koganei stations after the earthquake.

Data transport of international and domestic VLBI observations are made via e-transfer, rather than via physical shipping of recorded data disks. Depending on the request, Mark 5 data or K5 data are stored and provided to the correlator from our data server, which is accessible from the Internet with a 1 Gbps connection.

VLBI Experiments for Frequency Comparison: The Space-Time Standards Laboratory is in charge of keeping the national standard time of Japan and is developing optical frequency standards for the primary frequency standards of the next generation. The main mission of the VLBI group of NICT is the development of a VLBI system that could be used for frequency comparison between optical frequency standards at intercontinental distances. For this purpose, a new VLBI system with small diameter antenna pairs and a wideband observation system are under development [3]. Before the new VLBI system becomes available,

test experiments with the 11-m antenna pair will have been conducted several times for a feasibility study of frequency comparison.

Astronomical Observation: A flare up of the galactic center Sgr-A* of our galaxy is predicted to occur in the summer of 2013 by Glissen et al. [4]. Based on the proposal by Miyoshi et al. [5] and Tsuboi et al. [5], monitoring observations of the flux variations of Sgr-A* in S/X-band were conducted in June, October, and December in 2012. The observations will be continued until the fall of 2013 at least.

Receiving the Down-link Signal from STEREO Spacecraft: The Koganei 11-m antenna has been used to download data from the STEREO spacecrafts[1] in cooperation with the Space Weather and Environment Informatics Laboratory of NICT. When VLBI sessions or maintenance work were not scheduled, the Koganei 11-m antenna has been mostly used for tracking the STEREO.

5. Future Plan

The antenna performance of the Koganei 11-m antenna is about 60% with respect to that of the Kashima 11-m antenna. The reason for this degradation is not known yet. We are going to investigate the reason and to recover the performance of the Koganei 11-m antenna to the same level with that of Kashima 11-m.

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.

[3] Takefuji, K. et al., Technology Development Center at NICT, International VLBI Service for Geodesy and Astrometry 2012 Annual Report, edited by K. D. Baver and D. Behrend, 2013, this volume.

[4] Gillessen, S., et al., A gas cloud on its way towards the supermassive black hole at the Galactic Centre, Nature, Volume 481, Issue 7379, pp. 51-54 (2012).

[5] Miyoshi, M., et al., private communication, 2012.

[6] Tsuboi, M., et al., Short baseline VLBI Observation of 2013 Event of Sagitarius A*, Astronomical Society Japan Spring Meeting in 2013, B08a, 2012.

[1] Two STEREO spacecrafts were launched by NASA in October 2006 to investigate the solar terrestrial environment and to provide 3D images of the Sun and solar storms.