

VERA Geodetic Activities

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Abstract

This report describes the status of the VERA network in terms of geodetic VLBI. The main contents are information about the technical parameters of the VERA observation system and a summary of geodetic VLBI activities during 2007.

1. General Description

VERA is a Japanese domestic VLBI network operated by Mizusawa VERA Observatory, NAOJ. Four antennas, Mizusawa, Iriki, Ogasawara, and Ishigakijima, form this array. Each station is equipped with a 20m radio telescope and a VLBI data acquisition system. Observing frequency bands of VERA are S and X, K (22 GHz) and Q (43 GHz). The Iriki antenna is shown in Figure 1. The VERA array is controlled from the Array Operation Center at Mizusawa via Internet.

The primary scientific goal of VERA is to reveal the structure and dynamics of our Galaxy by determining 3-D force field and mass distribution. Galactic maser sources are used as dynamical probes, positions and velocities of which can be precisely determined by phase referenced VLBI relative to extragalactic radio sources. The distance is measured as a classical annual trigonometric parallax. VERA standard astrometric observations started in 2003. Distances of several maser sources were measured in 2007.

Geodetic observations with VERA started in late 2002 and have been done routinely since late 2004. Monitoring of positions and movements of VERA sites by geodetic observations contributes to keeping the accuracy of the VERA astrometric measurements. Geodetic observations are made in S/X- and K-bands.

General information about the VERA stations is summarized in Table 1 and the geographic locations are shown in Figure 2. Lengths of baselines range from 1000 km to 2272 km. Ogasawara and Ishigakijima are small islands in the open sea and their climate is subtropical.

Table 1. General information

Sponsoring agency	Mizusawa VERA Observatory, National Astronomical Observatory of Japan	
Contributing type	Network observing station	
Location	Mizusawa	141° 07' 57".2E, 39° 08' 00".7N, 75.7m(a.s.l.)
	Iriki	130° 26' 23".6E, 31° 44' 52".4N, 541.6m(a.s.l.)
	Ogasawara	142° 12' 59".8E, 27° 05' 30".5N, 223.0m(a.s.l.)
	Ishigakijima	124° 10' 15".6E, 24° 24' 43".8N, 38.5m(a.s.l.)

2. Technical Parameters

Parameters of the antennas and the front- and back-end systems are summarized in Tables 2 and 3, respectively. The 1 Gbps recorder named DIR2000 is shown in Figure 3.



Figure 1. VERA Iriki antenna (foreground)

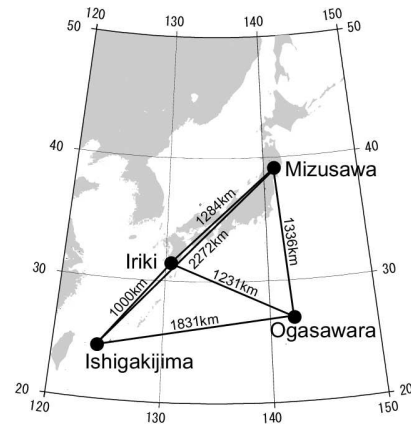


Figure 2. Location of VERA stations

Table 2. Antenna parameters

Diameter	20m		
Mount	Azimuth-Elevation		
Surface accuracy	0.2mm(rms)		
Pointing accuracy	<12" (rms)		
	S	X	K
HPBW	1550"	400"	150"
Aperture efficiency	0.25	0.4	0.47
Slew	Azimuth		Elevation
range	-90°-450°		5°-85°
speed	2°.1/sec		2°.1/sec ²
acceleration	2°.1/sec ²		2°.1/sec ²



Figure 3. DIR2000: 1 Gbps recorder used in VERA operations.

3. Activities of Geodetic VLBI Observation

Two observation modes are used for geodetic observations. One is the VERA internal geodetic observation. The observing frequency bands are S/X and K and the recording rate is 1 Gbps. The other is the joint observation with the Geographic Survey Institute (GSI) by Mizusawa's participation in GSI's domestic observation sessions called JADE. The purpose of the JADE participation is to obtain VERA's coordinates in the terrestrial reference frame realized by the IVS. Its frequency band is S/X and the recording rate is 128 Mbps. A K5-VSSP data acquisition terminal is used.

During 2007, VERA internal geodetic observations were carried out 20 times. These observations are divided into 17 K-band sessions and 3 S/X-band sessions. We tried changing the geodetic observation frequency from S/X to K. There seems to be no significant systematic difference in the estimated coordinates between S/X and K-bands. As a result, all sessions after October used K-band.

1 Gbps recording mode according to JADE schedule started at all VERA stations. The same observations raw data sent from Tsukuba 32m antenna via G-bit optical fiber network was recorded

Table 3. Front-end and back-end parameters

front-end					
Frequency band	Frequency range(GHz)	Receiver temperature	Polarization	Receiver type	Feed
S	2.18–2.36	100K	RHC	HEMT	Helical array
X	8.18–8.60	100K	RHC	HEMT	Helical array
K	21.5–24.5	39±8K	LHC	HEMT(cooled)	Horn
back-end					
Type	channels	BW/channel	Filter	Recorder	Deployed station
VERA	16	16MHz	Digital	DIR2000	4 VERA
K5-VSSP	16	4MHz	VC	HDD	Mizusawa

by using 1 Gbps recording system in the Mitaka Correlation Center. All VERA antennas were connected with the IVS network immediately due to this observation mode. This observation mode was operated 9 times during 2007.

Joint observations with the 11m telescope of Gifu University started in October. The telescope is linked to Mitaka via optical fiber and it is possible to record Gifu data by using a DIR2000 1 Gbps recorder at Mitaka.

4. Plans for 2008

Regular VERA Internal geodetic observations, the participation in JADE and 1 Gbps recording according to JADE schedule will be continued. Gifu 11m antenna will join semi-regularly the VERA internal observations in K-band and will be able to be regarded as the fifth station of VERA at least for geodetic purposes. Experimental observations with Tsukuba 32m antenna in the same mode will also be made.

Plans other than observations are improvement of software, such as model update and GUI, and improvement and automatization of data analyses.

5. Staff Members

The VERA team of NAOJ consists of 9 scientists, 7 technicians, and 5 post-docs. Among them, the members of the geodesy group are S. Manabe (chief, scientist), Y. Tamura (scientist), T. Jike (scientist), and M. Shizugami (software technician).