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VLBI Activities of Tsukuba 32-m Station and Tsukuba Correlator

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Abstract. We present an overview of the VLBI activities of Tsukuba 32-m station and Tsukuba Correlator by Geographical Survey Institute (GSI), Japan. During 2005 to 2007, we succeeded in introduction of K5/VSSP32 sampling/recording system, K-band (22 GHz) receiver and Parnassus (K5 correlation aiding software). On the other hand, we started observation with e–VLBI. In addition, with a prospect of becoming an IVS Analysis Center in the future, we are putting the global analysis into practices experimentally.

1. Tsukuba 32-m Station Observation Components

1.1. K5/VSSP32 SYSTEM

Tsukuba 32-m station introduced the K5/VSSP32 sampling/recording system (Fig. 1, Tabl. 1).
History:
Until May 2005
Mark 4 tape recording.
May 2005
K5/VSSP HDD recording started.
–At the beginning, we had some troubles.
March 2006
K5/VSSP32 was bought.
–About one year, we had made the testing and adjustment.
May 2007
K5/VSSP32 HDD recording started.
–No data missed!
(Fig. 2)

Table 1. Comparison of Specifications

	K5/VSSP	K5/VSSP32
Sampling frequency (MHz)	0.04, 0.1, 0.2, 0.5, 1, 2, 4, 8, 16	0.04, 0.1, 0.2, 0.5, 1, 2, 4, 8, 16, 32, 64
Built-in digital LPF (MHz)	N.A.	2, 4, 8, 16, through
Analog Input range	-1V to +1V	-1V to +1V
Analog Bandwidth	100 MHz	300 MHz
AD resolution (bit)	1, 2, 4, 8	1, 2, 4, 8
Number of channel per unit	1, 4	1, 4
Maximum Data Rate	16 Mbps/ch 64 Mbps/unit 256 Mbps/module	64 Mbps/ch 256 Mbps/unit 1024 Mbps/module
DC offset adjust	N.A.	available from host PC
Reference signals	1PPS, 10 MHz	1PPS, 10 MHz or 5 MHz
Interface to PC	PCI bus	USB 2.0

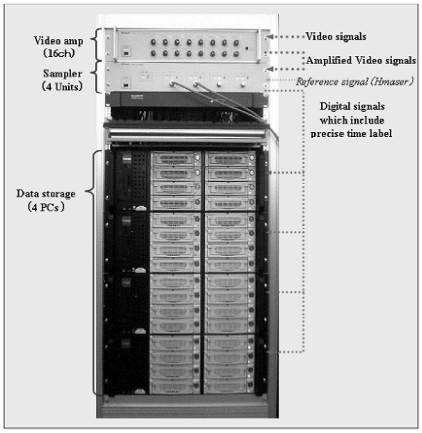

Figure 1. K5/VSSP32 system

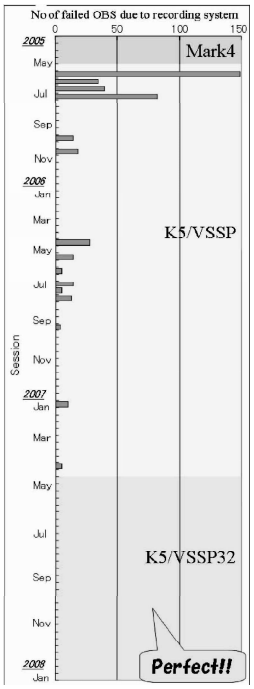

Figure 2. Number of failed OBS due to each recording system

1.2. K-band (22 GHz) Receiver

In a collaborative research with Tsukuba University, a K-band (22 GHz) receiver (Fig. 3) was introduced to the Tsukuba 32-m antenna.

History:
2006
–design and develop of 22 GHz receiver,
–set up and test of 22 GHz receiver,
–adjustment of observation system,
–test observations.
2007
–set up of related equipments,
–investigation to remove the standing wave,
–adjustment of 22 GHz receiver,
–pointing,
–single dish observation by Tsukuba University,

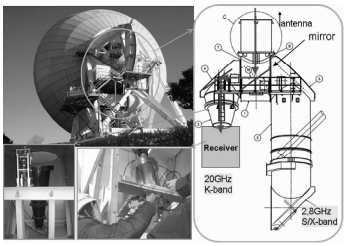

Figure 3. K-band (22 GHz) receiver

They succeeded in observing recombination lines, ammonia and water-vapor maser lines and continuum emission, in Dec. 15–16, 2007.
2008
–single dish observation.

1.3. The Special Maintenance and the Purchase of New Equipment

As the antenna and observation equipment show some signs of wearing out after 10 years of usage, we need special maintenance and the purchase of new equipments.

A panel of Tsukuba 32-m antenna fell down in strong wind in Jun. 2007 (Fig. 4).
We did "Total Check up" in Sep.–Oct. 2007.
–All bolts were tightened and problems were dug up.
–Worn-out antenna rail was pointed out in the check.

2. Observation with e–VLBI

Tsukuba 32-m station transfers the international VLBI observation data to correlator using high-speed network (Fig. 5). Since 2007, we have endeavored to observe with e–VLBI, and achieved rapid processing in UT1 measurement (Tabl. 2).

Figure 4. Tsukuba 32-m antenna repairing

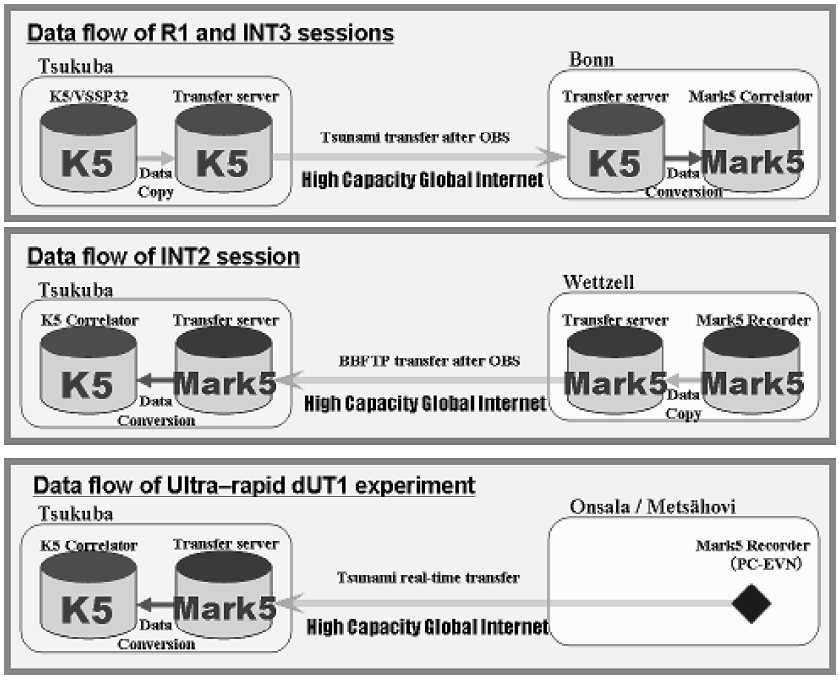

Figure 5. Data flow each session

3. Tsukuba VLBI Correlator: Development of Parnassus

We had developed Parnassus (Fig. 6), which is an intelligent application with graphical user interface to aid the operation of K5 kernel programs, during 2005 to 2007.

Table 2. Comparison of each UT1 measurement sessions

Session	Data Transfer Method (Transfer Time)	Latency Period of UT1 measurement	Stations	Correlator
INT1	Shipping (2–3 days)	3–5 days	Wz,Kk, (Sv)	Washington
INT2	BBFTP Transfer (about 3 hours)	1–3 days	Ts,Wz	Tsukuba
INT3	Tsunami Transfer (about 30 minutes)	a few hours	Ts,Wz, Ny	Bonn
Ultra-rapid dUT1	Tsunami Real-time Transfer (Direct)	a few minutes	Ts,Kb, On,Mh	Tsukuba Kashima

History of Parnassus development:
2005
–Ver1.0 Set up of correlation.
2006
–Ver1.2 Bandwidth synthesis covered.
2007
–Ver1.3 Corresponds to key program (by NICT) upgrade.
2008
–We would like to make all the processes automatic and faster.

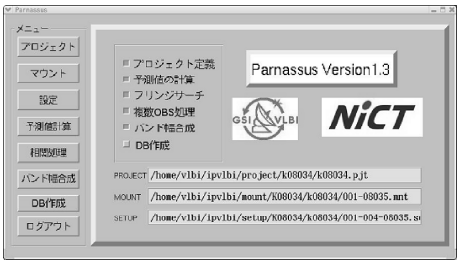

Figure 6. First screen of Parnassus

Feature of Parnassus:
–Automatic fringe search with the coarse search function.
–Making of a priori file, automatic correlation, and the bandwidth synthesis in two or more obs and baselines.
–Various settings of processing can be done on the GUI screen.

4. Various VLBI Analysis Activities

We are putting various VLBI analysis into practice experimentally, with the prospect of becoming an IVS Analysis center in the future.
We have been doing various VLBI analysis:
– The analysis for 24-h sessions
(We have analyzed about 4 times/year latest result: gsi2008a),
– The analysis for 1-h sessions

(We have analyzed about 4 times/year latest result: int2008a),
- The analysis for CONT05 sessions
(We have analyzed after CONT05 result: cont05).

References

[1] Fujisaku, J., K. Kokado, K. Takashima. Tsukuba 32m VLBI station. IVS 2005 Annual Report, 2005.

[2] Kokado, K., J. Fujisaku, K. Takashima. Tsukuba 32m VLBI station. IVS 2006 Annual Report, 2006.