

# Fundamentalstation Wettzell - 20m Radiotelescope

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## Abstract

In 2004 the 20m-Radiotelescope Wettzell contributed strongly to the IVS observing program. The transition to the Mark 5A system has been completed and the system is used for routine operation. A 34Mbps Internet link has been installed. In particular the Intensive observations were the candidates for e-VLBI activities. Technical changes, improvements and upgrades have been done to increase the reliability of the entire system.

## 1. General Information

The Radiotelescope Wettzell (RTW) is jointly operated by the Bundesamt für Kartographie und Geodäsie (BKG) and the Forschungseinrichtung Satellitengeodäsie/Technical University of Munich (FESG) within the frame of the Forschungsgruppe Satellitengeodäsie (FGS).

At the Fundamentalstation Wettzell (FSW) the 20m Radiotelescope (RTW) for VLBI is collocated with 3 other geodetic space technique systems:

- the laser ranging system WLRs (Wettzell Laser Ranging System) designed for SLR and LLR,
- several GPS receivers, integrated in the global IGS, the European GPS, and in the national GPS network, and for time transfer experiments,
- a DORIS station on loan from CNES/France.

At the Wettzell observatory, the first ringlaser “G” dedicated to the monitoring of the variations in Earth rotation has been developed in close cooperation with the University of Canterbury, New Zealand. The system was established in 1998 to 2001 and is operating since fall 2001. “G” is sensitive to monitoring daily variations better than  $10^{-8}$  relative accuracy.

Additional in situ observations were carried out such as

- gravity observations, employing a super conducting gravity meter
- earthquake observations with a seismometer
- meteorological observations to monitor pressure, temperature and humidity, rain fall, wind speed, wind direction and also
- water vapour observations with a radiometer.

A Time and Frequency system (T&F) is established for the generation of timescales (UTC(IfAG)) and for the provision of very precise frequencies needed for VLBI, SLR/LLR and GPS observations, employing Cs-clocks and H-Masers and GPS time receivers. The time scale UTC(IfAG) is published in the monthly Bulletin T of the BIPM.

## 2. Staff

The staff of the Fundamentalstation Wettzell consists in total of 35 members for operating, maintaining and improving all the devices, and developing new systems. Within the responsibility of the Fundamentalstation Wettzell, are the TIGO systems, operated in Concepción-Chile jointly with a Chilean partner consortium with 3 experts from Wettzell, and the O'Higgins station, jointly operated with the German Space Center (DLR) and the Institute for Antarctic Research Chile (INACH). The staff operating the 20m Radiotelescope Wettzell (RTW) is summarized in the Table 1.

Table 1. Staff - members

Name	Affiliation	Function	Working for
Wolfgang Schlüter	BKG	head of the FSW	RTW, TIGO, O'Higgins
Richard Kilger	FESG	group leader RTW	RTW
Erhard Bauernfeind	FESG	mechanical engineer	RTW
Ewald Bielmaier	FESG	technician operator	RTW
Christian Hupf	FESG/BKG	student	RTW
Gerhard Kronschnabl	BKG	electronic engineer	RTW, TIGO (partly), O'Higgins (partly)
Christian Plötz	BKG/FESG	electronic engineer	O'Higgins, RTW
Raimund Schatz	FESG	software engineer	RTW (partly)
Walter Schwarz	BKG	electronic engineer	RTW, O'Higgins
Reinhard Zeitlhöfler	FESG	electronic engineer	RTW
Rudolf Zerneck	FESG	survey engineer	RTW, TIGO (partly)

## 3. Observations in 2004

RTW has participated in various IVS observing programs: R1, R4, T2, R&D, as well as VLBA and Europe. All these sessions run for 24 hours.

Additionally RTW participates in single baseline sessions to determine changes in rotational speed (UT1-UTC). These sessions are done once a day with 1 hour data recording and are called Intensives. This type of session is predestined to transfer recorded data by e-VLBI: the amount of recorded data is relatively small (35 Gbytes) and the interest to get results immediately after the observations is very high. Currently there are two types of Intensives:

- INT1 observed between Kokee and RTW from Monday through Friday.
- INT2 observed between Tsukuba and RTW on Saturday and Sunday.

The number of sessions done in 2004 is listed in Table 2.

INT1 is performed since April 1984 continuously with radiotelescopes in the US (Westford, Greenbank and Kokee). Presently INT1 is recorded with the Mark 5 system onto a single fixed disk. Starting August 06, RTW supported transfer of data via e-VLBI for 2 months. (Due to problems outside of Wettzell data transfer via e-vlbi has been stopped.)

Table 2. RTW's participation in IVS 24 hr and 1 hr observing programs

program	number of 24h-sessions
IVS R1	50
IVS R4	50
IVS T2	9
IVS R&D	10
VLBA	5
EUROPE	4
<b>in total</b>	<b>128</b>

program	number of 1h-sessions
INT1	211
INT2	60
<b>in total</b>	<b>271</b>

INT2 is a second single baseline Intensive session that is observed between Tsukuba and RTW and started in 2003. Data are recorded with K4-DAT on cassettes and correlated in Japan. From January until August 2004 the observation was performed on Saturdays. Starting in September 2004 observations were done also on Sundays. From that time 7 Sunday INT2 took place at Wettzell. The last Sunday of the month, the data are transferred via e-VLBI to Japan (without sending a tape or a disk in parallel). It is highly desirable to transfer the data via internet from a scientific point of view and cost of transportation.

#### 4. Maintenance

The intensive use of RTW requires maintenance in particular to avoid failures during the observations. Some problems were caused by failures of the receiver cooling system during the hot summer period. The antenna control unit (ACU) fails randomly for reasons unknown. At the end of 2004 the ACU was replaced by a new one.

#### 5. Technical Improvements

The transition from Mark IV to Mark 5A was successfully completed. Two Mark 5A systems were integrated (Figure 1). One of the units was modified for the Intensive observations as Intensives only require one disk per experiment and not a complete 8 pack. The second unit is used as spare and also to test and to develop e-VLBI procedures. The tape drives are still available.

For e-VLBI a 34Mbps internet connection is installed. Due to the policy of German Telecom, the higher rate of 155Mbps or even more is still much too expensive. The link in Wettzell can be extended to 155Mbps, as soon as it becomes affordable. The 34Mbps link allows the transmission of the Intensive data to the correlator. It is used monthly to send the Sunday INT2 observations to Kashima/Tsukuba. First tests with Haystack and USNO, which has access to high speed internet via ISI, located in the neighbourhood of USNO in Washington, were conducted in order to ship the INT1 observations.

To improve the reliability the following actions were taken:

1. Two new PCs (one as back-up) with the latest version of the Field System replaced the old



Figure 1. 2 MK5A systems, one with modifications for the Intensives (left); New Antenna Control Unit (ACU) (right)

PCs.

2. The un-interruptable power supplies (UPS), which support all the components of the Data Acquisition System, including Mark IV, Mark 5 and K4 was completely renewed, as the previous system did not meet the growing requirements. A total survival period of more than one hour is realized now.
3. The Dewar system has been improved through new vacuum valves and an automatic pumping station for better and faster maintenance.
4. The old Antenna Control Unit (ACU), which employed a PC with an old MS DOS operating system and which caused several unexpected failures of the antenna, was replaced together with related hardware and interfaces. The new ACU is based on the real time operating system "VxWorks". First experiences with the new ACU are promising, though some minor points still need improvements.

## 6. Upgrade Plans for 2005

During 2005 it is planned to make more use of the e-VLBI facilities and to increase the connection from 34Mbps to at least 155Mbps. Further, an upgrade of the Mark 5A to Mark 5B is foreseen.