Fundamentalstation Wettzell - 20m Radiotelescope

Richard Kilger

Abstract

2005 was a very successful year for the 20m-Radiotelescope in Wettzell/Germany contributing strongly to the IVS observing program. Technical changes, improvements and upgrades have been done to increase the reliability of the entire VLBI observing system.

1. General Information

The 20m-Radiotelescope in Wettzell (RTW) was designed in the years 1980-81 as a project of the former "Sonderforschungsbereich 78 Satellitengeodäsie" hosted at the Technical University of Munich. RTW is an essential component of Fundamentalstation Wettzell (FSW) and is jointly operated by Bundesamt für Kartographie und Geodäsie (BKG) and Forschungseinrichtung Satellitengeodäsie (FESG) of Technical University of Munich.

At the Fundamentalstation Wettzell (FSW) the following geodetic space technique systems are operated using the same Time and Frequency system (T&F):

- the laser ranging system WLRS (Wettzell Laser Ranging System) designed for Satellite Laser Ranging (SLR) and Lunar Laser Ranging (LLR) being integrated in ILRS; presently a new laser Satellite Observing System (SOS) is designed to be added to WLRS,
- several GPS receivers, integrated in the global IGS, the European GPS, in the national GPS network and in time transfer experiments,
- a ringlaser "G" dedicated to the monitoring of daily variations of Earth rotation with a relative accuracy of better than 10^{-8} and
- 20m-RTW being integrated into geodetic observing programs within IVS.

The 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, H-Masers and GPS time receivers. The time scale UTC(IfAG) is published in the monthly Bulletin T of BIPM.

Additional in situ observations were carried out, such as gravity observations with a super conducting gravity meter, earthquake observations with a seismometer, meteorological observations to monitor pressure, temperature and humidity including wind speed, wind direction and rain fall, water vapour observations with radiometer(s) and comparisons of its results with local radio sondes in April 2005 and during CONT05 in September, conventional geodetic control measurements to tie the reference points of the space geodetic systems RTW and SLR to the local terrestrial coordinate system and to investigate the local stability.

2. Technical Parameters of RTW

Figure 1 shows the Fundamentalstation Wettzell with the GPS antenna in front, to the left the WLRS, the RTW (center) and to the right the building for the new Satellite Laser Ranging System (SOS_W) which is currently built at Wettzell to house the highly automated SLR.

Figure 1. Fundamental Station Wettzell

The technical parmeters of RTW are shortly summarized below.
Geometry:

- General Concept: "Turning Head", Cassegrain geometry with coaxial adjusted main- and subreflector,
- Main reflector: mathematical rotational paraboloid with 20m diameter, 314 m^2 orthogonal aperture area and 9 m focal length
- Sub reflector: mathematical rotational hyperboloid with 2.7m diameter

Kinematic Data:

- Azimuth axis (angle of movement 251.5°....831°, velocity ± 3°/sec, acceleration ± 1.5°/sec^2)
- Elevation axis (angle of movement 1°.... 90°, velocity ± 1.5°/sec, acceleration ± 1.5°/sec^2)

Surface Tolerances:

- total error of main reflector ± 0.35 mm rms
- total error of sub reflector ± 0.02 mm rms

3. Staff

The staff of the Fundamentalstation Wettzell consists in total of 34 members for operating, maintaining and improving all devices and developing new systems. Within the responsibility of the Fundamentalstation Wettzell are also the

- TIGO systems (see station report in this volume), operated in Concepción, Chile jointly with a Chilean partner consortium with 3 experts from Wettzell and
- O'Higgins station (see station report in this volume) in the Antarctic jointly operated with the German Space Center (DLR) and the Institute for Antarctic Research Chile (INACH).

The staff operating RTW are summarized in Table 1.

Table 1. Staff - members of RTW

Name	Affiliation	Function	Working for
Wolfgang Schlüter	BKG	head of the FSW	RTW, TIGO, O'Higgins, T&F,...
Richard Kilger	FESG	group leader RTW	RTW
Erhard Bauernfeind	FESG	mechanical engineer	RTW
Ewald Bielmaier	FESG	technician	RTW
Gerhard Kronschnabl	BKG	electronic engineer	RTW, TIGO and O'Higgins (partly)
Christian Plötz	BKG/FESG	electronic engineer	O'Higgins, RTW (partly)
Raimund Schatz	FESG	software engineer	RTW
Walter Schwarz	BKG	electronic engineer	RTW, O'Higgins and WVR (partly)
Reinhard Zeitlhöfler	FESG	electronic engineer	RTW
Daniel Helmbrecht	FESG/BKG	student	RTW
Christian Hupf	FESG/BKG	student	RTW

4. Observations in 2005

Table 2 shows the scheduled and successfully observed sessions of the year 2005. It was the highest amount of observations ever performed in one year at RTW. Meanwhile RTW is the antenna with by far the most geodetic 24h-sessions in the last 20 years [CRUSTAL DYNAMICS, POLARIS, IRIS, NEOS, CORE, IVS(R1,R4, T2, R&D)].

The same is valid for the daily one hour Intensive sessions to determine Δ [UT1-UTC]. INT1 is the Intensive session performed together with Kokee (Hawaii, USA) — formerly done with Greenbank (WV, USA) and Westford (MA, USA)—on weekdays. INT2 is a supplementary East-West-Interferometer to determine Δ [UT1-UTC] by RT-Tsukuba and RTW observed on Saturday and Sunday, when INT1 (Kk-RTW) is not observed.

INT1 and INT2 are recorded in Mark 5 on single fixed discs. The recorded data are sent via Internet to the correlator in Tsukuba and now - since beginning of 2006 - to the Washington correlator as well. So Intensives are also progressive projects testing the new techniques to come in the near future.

Table 2. RTW participation in the IVS 24h- and 1h-observing programs

program	number of 24h-sessions
CONT05	15
IVS R1	49
IVS R4	50
IVS T2	6
IVS R&D	10
RDV/VLBA	6
EUROPE	4
MPI/EVN	1
in total	**141**

program	number of 1h-sessions
INT1	241
INT2	86
in total	**327**

5. Technical Improvements and Notes

By now all VLBI measurements at RTW are recorded on Mark 5: the last session recorded on magnetic tape was the RDV session RDV53 on September 28, 2005 correlated in Socorro. The

Intensive sessions with Tsukuba (Japan) and Kokee (Hawaii, USA) are recorded on a single disc with 120 Mbyte in a special crate with Mark 5; the data are transferred after the session to the correlators in Tsukuba and Washington via e-VLBI. RTW has a connection with 34 Mbit/sec for this purpose. No physical shipments of disks are carried out for Intensives. Mark 5 recording and e-VLBI have proven to be reliable in practical day-to-day operation.

Reliability of operation was a main issue at RTW in 2005. It was increased, among other things, by implementing a new software in the antenna control unit (ACU). With correctly adjusted azimuth limits (CW- and CCW) the antenna runs now according to the guidelines set by the Field System. One additional advantage is that the antenna no longer runs "long ways" in azimuth and loses one or — worst case — two scans. This is especially important in Intensives sessions that only have about 20 scheduled scans.

Due to a vast quantity of VLBI measurements — 141 24h-session days in 2005 — the DC-motors of the azimuth axis were heavily loaded (and suffered during some R&D sessions. During the summer time R&Ds of up to 800 scans over 24 hours caused the measured temperatures on the outer surface of the azimuth motors and gearings to climb to 70°C!) In September 2005 before CONT05 we got warnings (over-current) for one of our azimuth motors. The collector area of this motor was worn out and the coal contacts caught fire. This azimuth motor has been replaced. Four identical azimuth motors were ordered. It turned out that it is difficult to impossible to adjust the four azimuth motors perfectly, if the motors have — even only small —different electric characteristics. With 4 new azimuth motors as spare RTW can maintain the high operability of the antenna in periods with many observations such as CONT05.

Another place to see the heavy loading are the parallel keys of the motor shafts of the azimuth motors; meanwhile they have to be replaced after one year of operation (Figure 2).

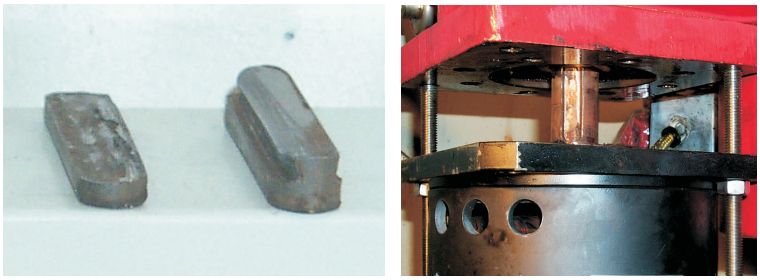

Figure 2. Destroyed keys and motor shafts

6. Upgrade Plans for 2006

During 2006 RTW plans to keep up its standard in observing quality and quantity. Some special points will be to upgrade its 34 Mbit/s Internet connection to about 155 Mbit/s, to integrate digital baseband converters (if already available), to start plans for a new VLBI-system/VLBI2010 in Wettzell.